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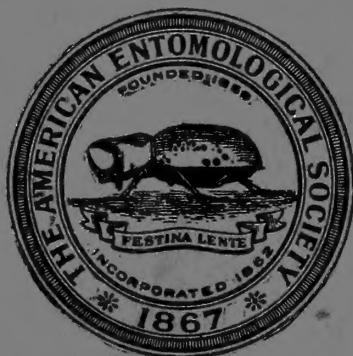
OF THE  
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NUMBER 14  
INSECTS

CLASSIFICATION OF THE  
BLATTARIA  
AS INDICATED BY  
THEIR WINGS

(ORTHOPTERA)

BY

JOHN W. H. REHN



PUBLISHED BY THE AMERICAN ENTOMOLOGICAL SOCIETY  
AT THE ACADEMY OF NATURAL SCIENCES  
PHILADELPHIA

1951

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CLASSIFICATION OF THE BLATTARIA AS  
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(ORTHOPTERA)

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INTRODUCTION

The Blattaria have long been recognized as one of the major groups of the Orthoptera. However, the classification of the major components of the group has not progressed adequately with the description of newly discovered forms. In addition, the wings of this group have never been surveyed to see if they would furnish a guide to the relationships of the various components. It is for these reasons that the wings of representative genera have been examined for the present study. These organs have been found to present features that are useful for the classification of this group.

An active association with the orthopterists at the Academy of Natural Sciences of Philadelphia has allowed me to examine the unusually representative collections of Orthoptera at that institution. Even more important, however, has been the opportunity to be present at, and in many instances instigate, discussions on the classification of

the orthopteroids. At such times, has been made available the results of years of intimate contact and research in this group. Both the unwritten but mentally matured ideas as well as the impressions and suppositions have been aired. During such sessions an interest in the broad classification of the complex was first developed and later stimulated. While obtaining entomological training at Cornell University the desire for a revision of the classification of the orthopteroids was further encouraged.

During the last decade attempts have been made by a number of workers to clarify and revise the classification of various portions of the order,<sup>1</sup> particularly the Acridoidea (1 & 2) and Gryllacrididae (3). As certain other groups, such as the Mantiaria (4), did not appear to be in such complete turmoil, the Blattaria were chosen for study. An additional impetus to the study of this group was the remarkable distinction between the classification of the recent and fossil forms. Although the present work does not attempt to integrate these components it is hoped that after obtaining sufficient knowledge of the existing forms a correlation may be attempted.

It is with this unique preparation that the analysis of representative material and a revision of the classification is presented. It is well known that the Philadelphia group is interested in the broad classification of the Orthoptera. With immense collections available and the feeling that there is more than enough for all interested, this study has been undertaken.

Grateful acknowledgment of the suggestions, criticisms and opinions and for the basic ideas for this study are due to Professor W. T. M. Forbes. It is as a result of his personal direction and the interest started by his paper on the axillary venation of insects (5), that the present study has been completed. Also to Dr. V. S. L. Pate for his unlimited helpful understanding, interest and suggestions which have materially aided in all stages of the present work are due my grateful thanks. My sincere thanks go to the late Morgan Hebard and to J. A. G. Rehn of the Academy of Natural Sciences of Philadelphia for their aid, opinions and criticisms and for their large part in making the present study a reality.

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<sup>1</sup> Subsequent numbers in parenthesis throughout the text refer to numbered references to literature which appear at the end of the paper.

To the authorities of the Academy of Natural Sciences of Philadelphia for placing the material for the present work at my disposal are due my sincere thanks.

For the present study sixty-eight genera of Blattaria were critically examined and are illustrated, while numerous additional genera were surveyed. In practically all cases, male and female of the same species were available for comparison and study of sexual dimorphism. In most cases the genotypic species was examined. This was done whenever possible in order that any changes found necessary would not necessitate the revision of existing generic concepts. In those cases where the genotype has not been examined, it is believed and hoped, that the form selected does not differ significantly from the typical one. In certain cases, small to fair sized series of the species, usually from the same locality, were examined in order to study variation. This latter has been particularly helpful in ascertaining what features may be considered reliable. In all cases, where it is possible, the person originally determining the individual figured has been mentioned.

The selection of genera for this study was carefully conceived. Consultation with other orthopterists at the Academy of Natural Sciences of Philadelphia and with Dr. W. T. M. Forbes, as well as personal knowledge, was utilized. An attempt was made to pick representative forms from each of the known distinctive, or supposed distinctive, groups of the Blattaria. It is, therefore, believed that at least most of the major entities have been represented in this study.

Two supposed distinctive groups have not been examined. These are the Nocticolinae and Archiblattinae. Individuals of neither of these groups have been available for study. In working from the published information concerning them, a tentative placement has been made. It would seem that the Nocticolinae are extremely specialized Blattidae. Their cavernicolous habits have probably led to the reduction of the tegmina and wings. As a result, few if any important venational features are retained. The Archiblattinae would seem to be related to the Blattinae. The degree of relationship cannot be ascertained from existing illustrations or discussions. The genus *Archiblatta* would seem to represent a very primitive, archaic type.

It is well recognized that a study of a single set of organs or a single system will not give one sufficient information for a complete and detailed classification. It is believed, however, that this study of the wings will at least clarify certain points and it is here used to establish a modified classification.

#### CHARACTERIZATION OF THE BLATTARIA

The Blattaria as a group constitute one of the most easily recognizable assemblages of the Orthoptera or for that matter of any of the insects. It seems advisable to treat them as a series, or as a superfamily, in the suborder Dictyoptera. By so grouping them with the Mantidaria and with an indefinite number of fossil forms in one suborder their basic relationship is indicated. The following characterization should serve to distinguish the Blattaria from the other Orthopterous insects.

Usually broadly oval and somewhat flattened in form; head free, usually inflexed, nearly or completely concealed by the shield-like pronotum; mouth directed posteriorly; maxillae and labium of an omnivorous or carnivorous type, former with galea slender, latter with both the glossae and paraglossae equally developed; maxillary palpi with 5 articles, labial palpi with 3 articles; ocelli, if present, normally two; antennae long, filamentous, annulate and multi-articulate; pronotum large, normally transverse, laterally expanded; tegmina and wings variable, fully developed to completely absent; legs strong, the three pairs essentially similar; coxae large, approximate, and not separated by a quadrate sternal plate; femora with apical spurs usually present; tibiae usually spinose; tarsi 5-jointed; abdomen usually with ten visible tergites; cerci prominent, jointed; males with styles which are usually visible.

Eggs covered with some type of a capsula (oötheca), although some forms retain this within the body and are ovoviviparous.

Alimentary canal long and sinuous, crop large, gizzard with powerful masticatory armature; eight tubular enteric caeca, malpighian tubules in six groups.

#### THE CLASSIFICATION OF THE BLATTARIA

Many diverse classifications of the Orthoptera have been evolved since Linnean time. The relative rank of the major divisions and the methods of this subdivision and arrangement have been numerous and for the most part far from satisfactory. The Blattaria always have been recognized as one of the major divisions of the order. As such a division, they have been given a rank varying from a genus in

Linnaeus' classification to an order by such workers as Handlirsch. This latter worker recognized in addition the order Protoblattoidea for a great mass of fossil forms. Moreover, he grouped all of these cockroaches with the mantids into the "Unterklasse; Blattaeformia." No general agreement has been reached upon the relative rank of this complex, and its subdivisions. At first, groups were based on rather careful work, but many have grown by accretion until they are no longer natural entities. A brief resumé of their classification follows.

In the tenth edition of Linnaeus' (6) *Systema Naturae* (1758), the genus *Blatta* was proposed and, with other genera now considered to be Orthoptera, was placed in the Coleoptera. In his later work, Twelfth edition (7, 1767), these same insects were placed in the Hemiptera. In 1773, De Geer (8) recognized the artificiality of this arrangement and proposed, for what is now generally called the Orthoptera, the order Dermaptera. Although this name is the oldest for the entire group, subsequent restriction has limited it to the forms commonly known as Earwigs.

Olivier (9), in 1789, applied the name "Orthoptères" to most of the then recognized genera. This system was followed by Lamarck (10) in 1801.

In a classification devised by Leach (11), in 1815, the blattids were removed from the other Orthoptera and he gave to them the name Dictyoptera. This has been changed by later workers to Dictyoptera.

Still another grouping was made by Latreille (12), in 1817. At this time, he divided the order into two sections placing *Blatta*, *Mantis*, *Phasma* and *Forficula* in the Cursoria and the remainder of the Orthoptera in the Saltatoria. This classification with minor additions and changes was often used for a long period.

Burmeister (13), in his *Handbuch* (1838), arranged this group in twenty genera and a number of subgenera. In all, over one hundred and twenty species were recognized. He erected a number of the genera which later workers have used as a basis for higher groups. Certain characters of the wings were used for this classification, but venation as such, was considered as incidental except in one case. Serville (14), in 1839, in the classic work on the Orthoptera, recognized ten genera, one subgenus and eighty species of Blattaria. Throughout the following decades a considerable number of workers described

numerous forms. The next major works were those of Henri de Saussure (15, 1862, 1864) in which well over fifty additional forms were described, and wing venation was used rather extensively.

The classic work on the Blattaria is that of K. Brunner von Wattenwyl (16, 1865). In this he recognized eleven tribes, over fifty-six genera, a number of subgenera and one hundred seventy-eight species. In most cases, these tribes represent groups which are still utilized. However, their limits often have been modified and their relative rank changed. This publication erected what might be termed the first modern classification. In addition, it was one of the early works to use wing venation for diagnosis and characterization. Even to this day, due to its comprehensiveness, it is one of the most helpful pieces of literature concerning the group.

Walker's catalogue (17, 1868) unfortunately appeared before the author could see Brunner's *Nouveau Système*. In it, six hundred ninety-six species are recognized and these are placed in a great many families. The same author (18), in 1869, issued a supplement which for the most part includes reference to the species described by Brunner, but also describes a few new forms. Neither of these advanced the classification of the group, but more often added confusion instead of clarification.

During the next decade, the numerous works of Saussure (19) added materially to our knowledge of this group. At this time, both Saussure and Brunner (20) were actively working and their various publications supplemented and amplified their own and others' findings.

Kirby (21), in his synonymic catalogue of the Orthoptera (1904) divided the Blattaria into sixteen subfamilies. These were essentially those erected by Brunner with the addition of the Chorisoneurinae, Nocticolinae, Archiblattinae and Plectopterinae. In earlier work, his Polyphaginae has been termed the Heterogamidae. Also the Chorisoneurinae and Oxyhaloinae had been considered as a unit. In this catalogue two hundred thirty-seven genera were recognized and almost two thousand species (1997).

After the turn of the century several classifications of the orthopteroids were proposed. Verhoeff (22, 1903) claimed that the mantids and blattids constitute a separate order and termed it the Oöthecaria. In 1905 Navas (23) called the same complex the Dictyoptera. The

following year Krauss (24, 1906) considered the blattids to constitute a separate order.

Handlirsch (25), in his classic work of 1903, raised the orthopteroid complex to two subclasses. In one of these, the *Blattaeformia*, he recognized six orders, one of these being the *Blattoidea*. In his later work (26, 1906–1908) these subclasses were reduced in rank to superorders, but the ordinal rank was retained for the various components.

At about the time these changes in the basic classifications were taking place Shelford and other workers were revising some sections of the *Blattaria*. Shelford's (1907, 1908, 1910) revisions (27) of various subfamilies in fascicles of the *Genera Insectorum* helped clarify the picture. Shortly before this J. A. G. Rehn (28, 1903, 1904) started working on the complex. Later workers such as Chopard (29, 1922, etc.), Hanitsch (30, 1915, etc.), Hebard (31, 1916, etc.) and others added materially to our knowledge.

Karny (32), in 1921, attempted a revision of the major components of the orthopteroids and endeavored to correlate the recent and fossil forms. This paper on the classification of the *Orthopteroidea* while instructive and interesting has not been followed by many workers. In the portion dealing with the blattids most of the conclusions do not seem to have been based on the examination of sufficient material. However, this attempt led Handlirsch to revise his previous classification. Thus, the classifications appearing in such works as Schroeder's (33, 1921) and Kukenthal's (34, 1929) handbooks are in actuality a revised Handlirschian classification.

In numerous textbooks and some entomological treatises, a number of workers have followed the tendency to split the group into a large number of families. For example, Brues and Melander (35, 1932) in their classification of insects recognized twenty-four families in the *Blattaria*.

On the other hand, most of the working orthopterists have been content to consider these entities as subfamilies or tribes. In recent years, a few have recognized some of the entities as being distinct families. However, very few have recognized all of these groups as of family rank.

In 1928, Forbes (36), in his study of the axillary venation of insects, pointed out some of the major differences in members of this complex.

In recent years, in addition to workers mentioned earlier, Bei-Bienko (37, 1941), Princis (38, 1946), Bruijning (39, 1948) and others have added materially to our knowledge of the group. The number of genera and species described by these workers is large.

Practically all workers have placed the new forms described within the classic subfamilies. Chopard and Hebard have redefined some of these components. An example of this is Chopard's (40) recognition of the Nocticolinae and Hebard's (41) division of the Ectobiinae and Chorisoneurinae in his treatment of the Australian forms of these subfamilies.

No recent attempt has been made to consider the classification of the Blattaria from the world-wide point of view. Numerous faunal works and generic revisions have been published. Rarely generic groups have been revised. With the accretion of knowledge the picture has become confused. It is interesting to note that while Kirby's catalogue is the latest for the group, since that time at least two hundred seventy genera and over fifteen hundred species of Blattaria have been described.

A conservative estimate of the size of the group at present would place it at four hundred fifty recognizable genera and somewhat more than thirty-five hundred species. It is well known that in various portions of the tropics and subtropics, which appear to offer optimum conditions, the fauna is as yet very incompletely known. No detailed, or for that matter well-founded, estimates on the number of existing forms can be made.

#### TEGMINA AND WINGS

The Blattaria while being basically winged insects, have achieved through various specializations, practically all possible conditions and combinations from fully alate to completely apterous (42). However, no cases are known in which the tegmina are reduced without a correlated reduction in the wing. In all but the groups of Blattaria with appendiculate fields, apterous and subapterous forms are known. In some of the complexes these conditions are widespread. In connection



with this, it is interesting to note that while uniform reduction in tegmina and wings often occurs in both sexes there are numerous instances in which such reduction occurs only in the females.

The system of names used in this study is based on the Comstock-Needham system of wing venation as amplified by Forbes. In addition certain terms used by various orthopterists have been incorporated. As a result of the study, certain limitations and amplifications of these terms were found necessary. In order to clarify this situation the following definitions are given.

In the Blattaria the venation is more richly branched than in the Comstock hypothetical plan. In all cases the major veins may be homologized but in some cases this is not true with the major branches. Usually where the homology is not evident these branches have been termed rami or sectors.

In some cases subcosta divides apically so that the branches are apparently comparable to  $Sc_1$  and  $Sc_2$  but in forms where the branches are numerous no homology can be determined.

The division of radius into  $R_1$  and a radial sector is usually evident, but the numerous subsidiary branches do not appear to have a homologue in the Comstock-Needham system. The apical posterior branch of the radial sector may actually represent the  $R_{4+5}$  of their system, but sufficient evidence is not available to draw definite conclusions.

In media it seems probable that the major branches when present are homologous with those of the hypothetical plan.

The cubitus with its great number of branches in most forms again differs from the hypothetical type. However, in those groups where there is a primary subdivision into stems or major branches, these may well be homologous to the  $Cu_1$  and  $Cu_2$  of the Comstock-Needham system.

The first plical vein, as pointed out by Forbes, is equivalent to the vein  $Cu_2$  of some Neuropterists and to the 1st A of others. It probably represents the  $CuP$  of other workers and is the *vena dividens* of orthopterists. It is not included in the Comstock hypothetical plan.

The second plical vein is called 1st A in the hypothetical form.

The third plical vein, which is present only in the wing, is not noted in the hypothetical wing plan.

Posterior to the convex fold, are the anal veins. At least the first of these is branched, and has been termed the branched axillary. The anal area is much more richly veined than in most other insects and the possible homologies with the anal veins of the hypothetical type have not been determined.

### *Explanation of Terms*

(Figures 1, 2, 3, 4, 5)

#### Alar Units

*Tegmen.* In the usual orthopterist style, used throughout for the mesothoracic wing.

*Wing.* Restricted to the metathoracic wing.

#### Margins

*Anterior margin.* Used for the costal margin of the tegmen to the point where it rounds or passes into the apical margin. In the wing it is used for the same relative portion or until it is intercepted by the fold which delimits the appendiculate field.

*Apical margin.* Used in the tegmen for the margin of the apex from the end of the anterior margin to the point where it passes into the posterior margin. In the wing it is used for that portion of the margin from the end of the anterior margin to the plical notch; or in those forms having an appendiculate field for the margin of this field. When a well-developed appendiculate field is present, it and its margin are usually divided into an anterior and posterior portion.

*Posterior margin.* Used in the tegmen for the portion of the margin from the apical margin to the plical notch. This is, in part, the sutural margin of some authors. This term is not used in the wings except for a portion of the margin of the appendiculate field.

*Margin of anal field.* In the tegmen this is the margin of the tegmen basad of the plical notch. In the wing, this is the margin of the wing posterior to the plical area or in those forms with an appendiculate field the portion posterior to its base.

#### Areas or Fields

*Humeral area.* Used in the tegmen for that portion of the tegmen anterior to the subcosta. It has not been found necessary to consider it as a separate entity in the wing.

*Plical field.* The area bounded anteriorly by the first plical and posteriorly by the third plical vein.

*Intercalated triangle.* The folded portion of the plical field which in repose is usually triangular in shape. In the Pseudomopinae it is normally bounded anteriorly by the first plical and posteriorly by the third plical vein.

*Appendiculate field.* That portion of the wing which is set off by a transverse fold; found in the Diplopteridae, Ectobiinae, Anaplectinae and Oulopterygidae.

#### Veins

*Costa.* The vein forming the anterior margin of the tegmen and wing, usually extending for a varying distance along the apical margin.

*Subcosta.* In the tegmen and wing this is the first vein behind the anterior or costal margin. It may be simple, forked apically, with anterior rami, or with posterior branches.

*Anterior rami of subcosta.* These are the branches going forward toward the costal margin before the tip of the vein. They may be regular or not, simple or branched; rarely clubbed in the wing.

*Posterior branch of subcosta.* Used for a condition noted in the tegmen. Apparently the basal anterior rami of the radius have become secondarily stalked on the subcosta and resemble a posterior branch.

*Radius.* The second major vein behind the anterior margin. It usually divides into a distinct  $R_1$  and a radial sector.

$R_1$ . This vein usually becomes free from the remainder of radius near the base. Anterior rami may be present or not. When some of these rami have become secondarily stalked on the subcosta they are termed the posterior branch of subcosta. At times a pseudostigma is formed in the wing along the anterior rami.

*Anterior rami of  $R_1$ .* These are similar to the anterior rami of the subcosta.

*Radial sector.* Used for the remainder of radius after the branching into  $R_1$ . It may have anterior and apical sectors as well as the apical posterior branches.

*Anterior rami of radius, or anterior rami of radial sector.* These are the branches that go toward the anterior margin, comparable to rami of the subcosta and  $R_1$ . They may be simple, irregular, secondarily branched, or fused apically.

*Apical rami of radius, or apical rami of radial sector.* These are the anterior branches of the radial system that curve forward and toward the apical margin. They may be simple, or secondarily divided. Terminal twigging may be present.

*Apical posterior branches of radius, or apical posterior branch of radial sector.* Used for the most posterior main branch of the radial system possibly equalling  $R_{4+5}$ . It usually terminates at the apical margin, but may have secondary divisions which in turn may be branched. Usually, it is on a line with the main stem of radius, but may be posterior to this.

*Media.* This is the third main vein behind the anterior margin. It may be simple or have a number of branches, which may further subdivide. In general, a tendency towards the simplification of this vein is found throughout the group. Its origin is intimately connected, as a rule, with the arculus, usually rising from the top or middle of this vein. Rarely, it may be stalked basally on the radius.

*Cubitus.* This is the fourth vein stem behind the anterior margin. In the tegmen, it divides into a number of branches (sectors). At times, there are

two major divisions each with further subdivisions. These primary subdivisions are termed stems or major branches. In the wing, the branches are normally termed sectors and they may go to the apical margin or posteriorly to the plical furrow. All branches and sectors may show secondary division.

*First plical vein.* This is a vein immediately behind the cubitus and before the plical fold. It is usually a simple vein extending to the margin. In the tegmen, it apparently lies at the base of the plical furrow. In the wing, it is before the plical fold or furrow and rarely has terminal branches. This vein is apparently equivalent to the CuP of many authors.

*Second plical vein.* This vein is not evident in the tegmen except as a trachea. In the wing, it is immediately behind the first plical vein and before the plical fold. Primitively it is complete, passing to the wing margin, however, it is often reduced. It may be free apically or its apex may curve forward and join the first plical vein. At times, its basal portion is completely lost. This vein is apparently the second A of most of the holometabolous insects and the first A of the neuropteroids.

*Third plical vein.* This vein is not recognizable in the tegmen. In the wing, it is usually prominent, lying behind the second plical and when free, rising from the same sclerite, and before the branched axillary. It usually passes to the wing margin behind the plical notch when that is present. In forms with an appendiculate field supported by venation, this vein forms the support. Basally, it may be free or it may be stalked on the branched axillary.

Both the first and third plical vein may show some apical branching or twigging. This is particularly true in the Polyphagidae.

*Branched axillary (Branched anal).* In the wing this vein rises from the basal bar and is immediately behind the third plical vein. Typically, it gives rise to a variable number of branches, which are usually simple and further apart apically, but rarely there may be secondary branches. At times its more posterior branches cannot be differentiated from the remaining veins in the anal field.

*Anal veins.* In the tegmen all the veins posterior to the plical furrow are indicated by this term. In the wing these are the simple veins posterior to the branched axillary.

*Arculus.* In part an oblique or vertical crossvein and a portion of media, evident only in the wing. It is a strong, simple vein connecting the bases of media and cubitus. When media apparently rises from its middle, it may apparently connect radius with cubitus.

### *Tegmina*

(Figure 1A and B)

The tegmina (mesothoracic wings) vary considerably in texture, form, venation and apparently in function. Primitively their function seems to be not only an integral part of the flight mechanism, but also

COMPARATIVE TABLE OF TERMS USED IN DISCUSSION OF THE  
WINGS OF THE BLATTARIA

Margins & Areas	Hebard (45)	Shelford (46)	Saussure & Zehntner (47)	Saussure (48)	Brunner (49)
Anterior margin (tegmen)	Margin of marginal & scapular field (pt.)	Margin of mediastinal and marginal (pt.) areas	Margin of basal area and of marginal field	Margin of mediastine & costal (pt.) areas and of marginal field	Margin of marginal or mediastine & scapular field (pt. ?)
Anterior margin (wing)	Margin of anterior field (pt.)	.....	Margin of anterior field (pt.)	Margin of marginal field (pt.)	.....
Apical margin (tegmen)	Margin of scapular (pt.) & of discoidal (pt.) fields	Margin of marginal (pt.) & discoidal (pt.) areas	Margin of marginal field (pt.) and discoidal area (pt.)	Margin of costal area (pt. ?), marginal (pt.) and discoidal (pt.) fields	Margin of scapular field (pt.)
Apical margin (wing)	Margin of anterior field (pt.)	.....	Margin of anterior field (pt.)	Margin of marginal (pt.) and discoidal (pt.) fields	.....
Posterior margin (tegmen)	Margin of discoidal field (pt.)	Margin of discoidal area (pt.)	Margin of discoidal field (pt.)	Margin of discoidal field (pt.)	.....
Margin of anal field (tegmen)	Margin of anal field	Margin of anal field	Margin of anal field	Margin of anal field	Margin of anal field
Margin of anal field (wing)	Margin of posterior field	.....	Margin of posterior, intermediate or axillary and radiate fields	Margin of anal (pt.) and posterior fields	Margin of anal field (pt.)
Humeral area	Area bounded by marginal field	Mediastinal area	Basal area	Mediastinal area	Marginal or mediastinal field
Plical field or intercalated triangle	Intercalated triangle	Triangular apical area	.....	Intercalated or reflexed field	Triangular apical field
Appendiculate field	Appendiculate field	.....	.....	.....	.....

In this study, fields, except as noted above, are named for the vein supporting the area, *i.e.* radial field, median field and cubital field.



## COMPARATIVE TABLE OF TERMS USED IN DISCUSSION OF THE VENATION OF THE BLATTARIA—(Continued)

Veins	Abb.	Bruijning (43)	Chopard (44)	Hebard (45)	Shelford (46)	Saussure & Zehntner (47)	Saussure (48)	Brunner (49)
Media	M	Media	Median & discoidal (tegmen)	Median	Median or ulnar?	Median?	Median discoidal (pt.)	Median, (vena interno media), vena ulnaria anterior, vena spuria
Media branches or sectors				Branches of media (pt.)		Rami of median vein (pt.)		
Cubitus	Cu	Cubitus	Ulnar discoidal (wing)	Ulnar	Ulnar	Ulnar or median? median? anterior ulnar (?)	Discoidal (pt.)	Infra median or vena externo media, vena ulnaris posterior
Stems of cubitus or sectors				Branches of media (pt.)	Anterior ulnar posterior ulnar	Branches of media (pt.)		
First plical	1 pl	Postcubitus	Anal diviante (tegmen) ulnar (wing)	Anal or dividing?	Anal or dividing vein?	Posterior ulnar anal or dividing vein?	Anal & anterior & posterior anal	Anal (tegmen), dividing vein? (wing)
Second plical	2 pl							
Third plical	3 pl	Vena divdens	Anal					
Branched axillary (wing only)	br ax	Anal	Axillary	Axillary	Axillary (tegmen)	Axillary		Axillary (including) radiate-anal
Anal	a	Anal and axillary (anal & jugal)	Axillary	Axillary (tegmen) radiate (wing)	Axillary (tegmen)	Axillary radiate (wing)	Axillary (tegmen)	Axillary (tegmen) included with axillary-br. ax (wing)
Arculus	ar							

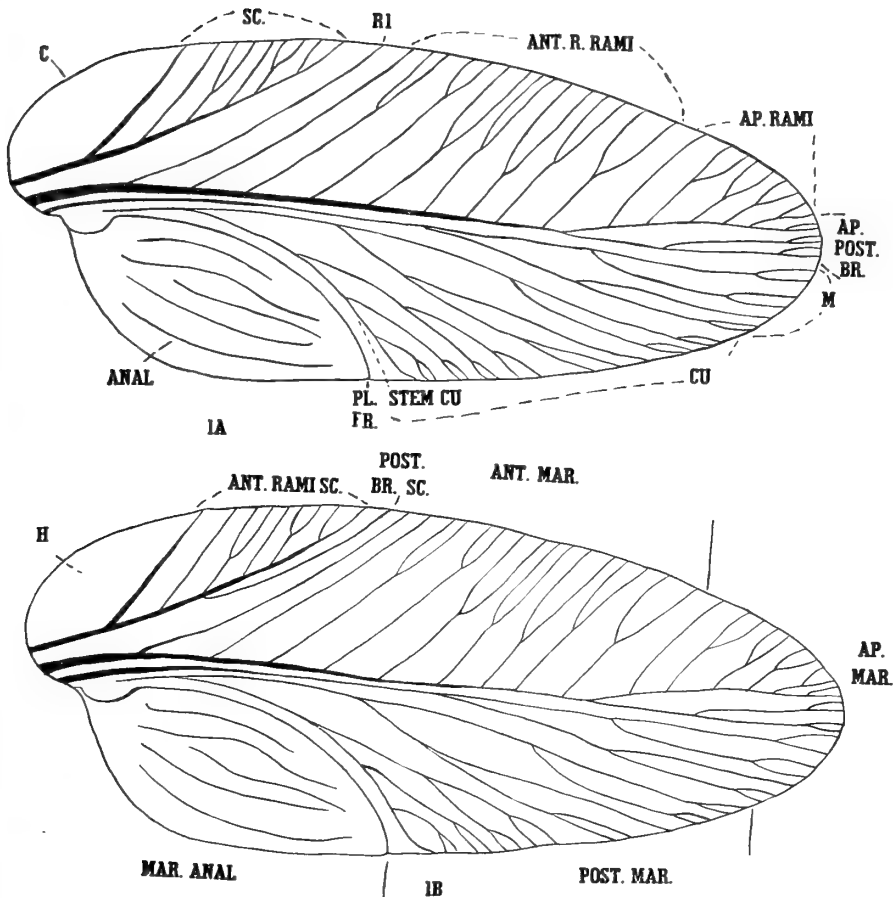
a covering for the metathoracic wings when these are in repose, and a protection for the abdomen. In the more advanced forms their use in flight is apparently more and more restricted while the protective value is amplified. In groups such as those with an appendiculate field they appear to serve mainly as a protection for the wing and abdomen. In females of some of the polyphagoid genera, which have relatively soft bodies and reduced wings, the tegmina apparently protect the dorsum of the abdomen.

In some of the groups of the Blattaria, the tegminal texture is essentially similar to that of the wings, but in most they are at least somewhat thickened, leathery or coriaceous. From this a further advance in thickness is noted particularly in the Corydiini, Perisphaerini and Oulopterygidae. In these the venation while still discernible is not prominent. An extreme condition is to be found in *Diploptera* in which the venation is subobsolete, the vein disposition being indicated by a few tracheae and the clear areas between punctures. The portion of the one tegmen that is covered when in repose is usually more membranous, or at least less coriaceous, than the tegmina as a whole. In all material studied, this has been the right tegmen. Rarely, as in *Holocompsa*, the tegmina are thickened and leathery basally and membranous apically.

In shape the tegmina, while basically elongate ovoid, vary from practically subtrigonal on the one hand to subrectangulate or subquadrate on the other. In most instances these latter conditions are correlated with varying degrees of wing reduction. The subtrigonal shape and its modifications occur when a distinctive form is necessary to cover the folded hind wing, and where the tegmina act only as a protective cover for the abdomen.

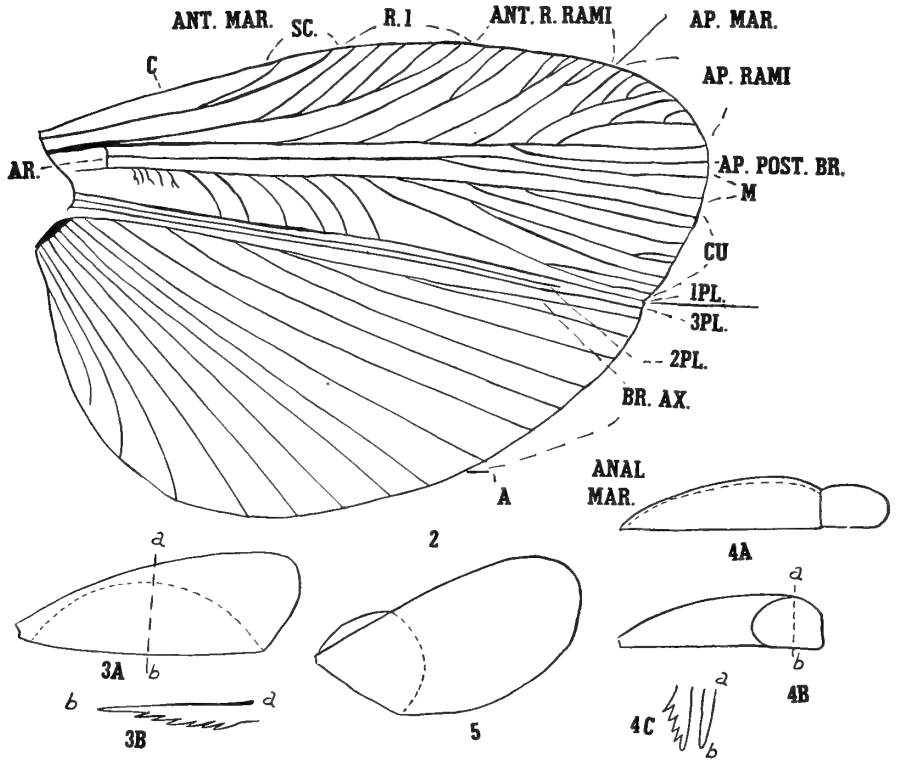
The tegmina are normally richly veined and in general have the following characteristics. The costa is strong and bounds the anterior margin. Possibly in some forms there is basally a trace of a precostal area. The subcosta is practically always strong, either simple, or with a varying number of anterior rami; at times it appears that at least one of the radial rami become stalked upon this vein. A ventral development of subcosta into a flange-like flap is noticed in some groups and it would seem to act as a tegminal catch or lock. The radius is also a strong vein and usually occupies much of the anterior portion of the





Text-figure 1.—A and B, diagram of tegmen.

tegmina. The apical posterior sector, while prominent in many of the more primitive forms, is progressively shortened and apparently lost in some of the more highly developed groups. The development of a number of anterior rami of the radius would appear to be one of the distinctive features of the Blattaria tegmina. Media, in the more primitive groups, is a strong, moderately branched vein but becomes reduced to a single stem. It may become either stalked basally on radius or cubitus. The marked reduction of this vein with the corresponding expansion of either radius or cubitus or both is again charac-



Text-figures 2 to 5.—Fig. 2, diagram of wing. Fig. 3A, diagram of wing folding in Blattidae. Fig. 3B, cross section of 3A. Fig. 4A and B, diagram of wing folding of form with an appendiculate field. Fig. 4C, cross section of 4B. Fig. 5, diagram of wing folding in Polyphagidae.

### *Explanation of Abbreviations*

ANT. MAR., anterior margin; AP. MAR., apical margin; MAR. ANAL, margin of anal field; POST. MAR., posterior margin; C, costa; CU, cubitus; H, humeral area; M, media; R1, radius 1; SC, subcosta; ANT. R. RAMI, anterior radial rami; ANT. RAMI SC, anterior rami of subcosta; AP. RAMI, apical radial rami; AP. POST. BR., apical posterior branch of radius; BR. AX., branched axillary; PL. FR., plical furrow; STEM CU, stem of cubitus; 1 PL., first plical vein; 2 PL., second plical vein; 3 PL., third plical vein.

teristic. Cubitus often divides into two main stems. The more posterior of these stems usually fills, with the exception of the well-marked anal area, the posterior half of the tegmina. The anterior stem forks

and may further subdivide. In the lower groups these divisions usually terminate at the posterior margin, but in the higher forms a reduction in the number of branches is noticed as is a change in their direction. The paralleling of the posterior margin by these branches and their ending at or near the apex is characteristic. The posterior branch of cubitus (CuP) lies in the distinct plical furrow and appears to be homologous with the first plical vein of the wing.

The plical furrow marks off the anal area and reaches the posterior margin at varying points in different groups. Whether the second and third plical veins are present in this fold has not been determined. A trachea representing the second plical is shown in Comstock's *Wings of Insects* (50) behind the furrow.

The area behind the anal furrow constitutes what has been retained of the anal fan. While the course of several veins may be traced, their actual homologies are not known, but tracheation indicates that both an anterior and posterior fan are present.

### *Wings*

(Figures 2-5)

The wings (metathoracic wings) while less variable in function and texture are considerably more diverse in venational types and form. When they are developed flight would appear to be their only function and when they are reduced so that this is not possible they appear to be functionless. They are usually membranous, rarely somewhat thickened and subcoriaceous. Exceptionally pseudostigmal areas are developed.

In form, wings that are definitely capable of supporting flight may be divided into two main types, first the polyphagoid with its large preaxillary and small anal areas, and second, that found in other existing types with a relatively large preaxillary area and with a greatly enlarged anal area. In the former, the length of the axillary furrow is always less than one-half the total wing length, usually about one-third, while in the latter this furrow is nearly equal in length to the total wing length except in those forms with an appendiculate field. In the groups with an appendiculate field this field is developed from the interplical area except in *Diploptera* and *Oulopteryx*, and it may be equal to twice the length of the radius. In *Diploptera* all major

venation crosses the transverse fold, thus representing still another type of development. In *Oulopteryx* an appendiculate field without venation is present. How this has arisen and its homologies are not known.

The venation of the wings is extremely diverse. Most of the major groups of the Blattaria have their own peculiar type of specialization. The costa forms the anterior margin of the wing and extends for a variable distance along the apical margin. In general, the subcosta is relatively prominent and may be either simple, forked or have rami, often with terminal twigging. The anterior rami are at times clubbed. At times capture of the anterior rami of radius is noted. When this happens they have been termed the posterior branches of the subcosta.

The radius is always well developed and normally has a distinct  $R_1$ , which may be simple or have anterior rami as in the subcosta. In some cases, it is not distinguishable from the anterior rami or the remainder of the radius. Normally the remainder of the radius has a number of anterior and apical rami, these latter often secondarily dividing. Usually an apical posterior branch of radius is present. This may be either simple or show secondary division. At times it has become indistinguishable or lost.

The media is always retained but varies from a primitive type with several distinct branches, to a simple, single vein. This vein may be taken as a guide to the degree of specialization of the group under consideration. The media usually apparently rises from the arculus, either from its top or from the middle; however, it may be stalked on the radius. The arculus is present in all but some of the Panesthiidae and is normally strong, either vertical or oblique.

The cubitus shows many types of specialization. Primitively it is a major vein with numerous diagonal, oblique sectors. One line of specialization is that having a division into at least two main stems each showing further subdivision. In some groups these sectors tend to pass to the plical furrow instead of to the apical margin. This tendency is carried to its extreme in certain of the Epilamprinae. On the other hand, a tendency towards the simplification and reduction in the number of its branches is evident in the Pseudomopinae. In this group the number of branches tends to be reduced and all attain

the apical margin. In forms such as those with an intercalated field it may be reduced to a simple, single stem.

The first plical vein is normally well developed and complete. In many of the Polyphagidae it has some terminal branches or twigging. However, in the Anaplectinae only the apical portion of this vein is retained the base being lost. This is the only group in which this condition has been noted. The second plical vein shows considerable variation. In the more primitive types it is often complete, extending to the apical margin. In different groups it is reduced to varying degrees. In these assemblages all conditions from free and complete to very short and ending in the first plical vein can be found. The third plical vein is normally complete. It is primitively free from the branched axillary in such groups as the Blattinae, Polyphagidae and others. In this latter group it often has apical branching. In more specialized groups it may be stalked on the branched axillary to varying degrees. This condition is noted particularly in the Epilamprinae and is carried to an extreme in the Thoracini. Another type of development is found in the Ectobiinae and Anaplectinae; in these forms the third plical has been elongated so that it is the only support for the appendiculate field. In the Diplopteridae the third plical supports the posterior half of the appendiculate field and has many irregular branches. The anterior portion of the field in this genus is supported by the major venation which crosses the transverse fold.

The branched axillary vein normally has two or more branches and may have as many as nine or ten. These are usually simple branches, but rarely some secondary branching may be noted. The area supported by this vein may be rather limited or may be equal to one-half of the anal fan. In the Polyphagidae there may be three branched axillaries. Behind this are a number of simple anal veins.

Crossveins are normally present throughout most of the wings, and it is only in certain of the more specialized forms such as the Ectobiinae, Anaplectinae and Oulopterygidae that they are reduced to a number that can be used in classification.

*Folding.*—The tegmina are not capable of being folded.

The wings have a number of methods of folding, but may be considered to consist of three basic types. First, the polyphagid type with its definite anterior and posterior fan in the anal area. The

wing folds along the plical area separating the preaxillary from the anal area. In this type the anal area is not folded fanwise. In all of the other groups the wing folds along this same area, but the anal area is folded fanwise, with alternating convex and concave folds.

Those forms with an appendiculate field, and the Diplopteridae and Oulopterygidae all have the fold along the plical area and a fan-like folding of the anal area, but, in addition, have the apical portion of the wing reflexed. This fold may only be slightly indicated with the apical area crumpled as in *Ectobius* or may be distinctly developed. The fold may be chevron-shaped or transverse. In these forms this apical area is normally reflexed on the dorsal surface of the wing. However, in the Oulopterygidae this area is coiled into a tight spiral. Thus not only by venation but also by the method of folding are the major groups of the complex more or less indicated.

#### *Methods*

In this study it was found necessary, in practically all cases, to remove the wings from the specimens examined. The large anal fan and the basal portion of the plical area can only rarely be examined by any other means. Usually both tegmina and wings were floated onto glass in either water or weak alcohol. By adjustment and combination of transmitted and reflected light details could be determined. In a few cases balsam mounts were prepared but were found less satisfactory than the wet preparations. The long established practice of orthopterists of mounting wings on cards, or linen ledger is definitely unsatisfactory as it is only through the use of transmitted light that some features can be ascertained.

For the drawing, the wings were often projected so that major features and proportions could be obtained. After this the sketch was checked, against the projected wing and the opposite wing of the same individual, and in most cases against additional material. No attempt was made to keep the drawings to any definite scale as the extreme variation in size would have resulted in drawings too small to be useful on the one hand and so large as to be cumbersome on the other.

After finishing with the studying of the wings, they may be fastened in their original position on the specimen, kept in fluid, made into permanent slides or into a permanent mount that can be placed beneath the specimen (51).



The following arrangement appears to represent the most logical linear sequence of the groups recognized in this study. However, like all linear arrangements it does not present a true picture of the relationship of the complexes.

The generic names used for the formation of group names are not always the oldest used for the group involved. However, they have been chosen because of their lack of ambiguity and in the belief that they are representative of the assemblages involved.

Family	Subfamily	Tribe
Polyphagidae	Polyphaginae	Polyphagini
		Corydini
		Tiviini
		Holocompsini
	Euthyrrhaphinae	Euthyrrhaphini
		Latindiini
	Latindiinae	Compsodini
		Panesthiini
	Panesthiinae	Panesthiini
	Diplopterinae	Diplopterini
Panesthiidae	Blattinae	Blattini
Diplopteridae	Nyctiborinae	Nyctiborini
Blattidae	Epilamprinae	Megaloblattini
		Calolamprini
		Oniscosomini
		Perisphaerini
		Leucophaeini
		Litopeltiini
		Epilamprini
		Nauphoetini
		Panchlorini
		Thoracini
		Paranauphoetini
		Phoraspidini
		Paratropini
	Brachycolinae	Brachycolini
	Blaberinae	Blaberini
	Pseudomopinae	Parcoblattini
		Eustegastini
		Euphyllodromiini
		Ischnopterini
		Euandrobattini
		Neoblattellini
		Pseudomopini
		Blattellini
		Supellini
		Symplocini
	Ectobiinae	Baltini
		Ectobiini
		Chorisoneurini
		Plectopterini
	Anaplectinae	Anaplectini
	Ceuthobiinae	Ceuthobiini
Oulopterygidae	Oulopteryginae	Oulopterygini



## POLYPHAGIDAE

The Polyphagidae have the tegmina less distinctive than the wings, but they possess a number of features of considerable diagnostic value. The presence of numerous subcostal and anterior radial rami is a condition parallel to that found in the primitive members of the Blattidae. The cubitus can be considered as a rather primitive type when compared with conditions found in other groups. A well-branched media, more freely branching than in other forms, can be considered both distinctive and as basic to the type from which the other Blattaria were developed. The finding of the first plical in the base of the plical furrow, and in at least some instances with its basal connection to cubitus still intact, shows the relationship of these veins. This condition is more primitive than that in the more evolved blattids. The occasional posterior development of the radius denotes a type of specialization not occurring elsewhere. In many of the members of the family the tegmina are membranous and very flexible. However, in the specialized forms, they have become densely coriaceous, more so than in practically any other groups except the Diplopteridae.

The wings are so distinctive in shape that they are immediately separable from all the other members of the Blattaria. The large pre-axillary area and the small unfolded lobate anal fan are unique. This area may have some wrinkles or incipient folds in the jugal area. The presence of a series of branched axillary veins, as well as the three complete plical veins, some of which show terminal twigging, separate the members of this family from all the others. The retention of a branched media is in common with other primitive forms of the Blattaria. The oblique cubital sectors are reminiscent of conditions found in the Blattidae, particularly in the Blattinae, and these conditions might be taken as basic to those found in such groups as the Epilamprinae. The presence of a well-developed radial system is also suggestive of that found in the primitive Blattidae.

In general the tegmina are elongate oval, either transparent and membranous or densely coriaceous. The anterior margin is weakly to strongly arcuate, with its greatest anterior expansion being approximately where the subcosta reaches this margin. The apical margin is strongly arcuate to subobtusely angulate, roundly passing into the posterior margin which is regularly arcuate to the plical furrow. This

latter is marked, as a rule, by a slight indentation or notch. The margin of the anal field is rounded to the tegminal base. The humeral area, particularly in the primitive forms, may be expanded, as in some Epilamprinae, but in the more specialized subfamilies this area shows reduction.

The subcosta is primitively heavy basally, straight to arcuate and with numerous anterior rami; rarely in certain advanced forms with posterior branches (*Dyscologamia*). This vein becomes simpler with advancement and in the most highly evolved forms is simple and almost straight. In this, it parallels the condition found in the Blattidae, while in the Panesthiidae, Diplopteridae and Oulopterygidae this vein is also heavy and simple, sinuate or arcuate. This vein normally reaches the anterior margin in the basal one-third to one-half in those forms with membranous tegmina. In those with coriaceous tegmina, which are normally somewhat reduced, it reaches this margin at or beyond the middle. The radius is usually well developed, but does not have a distinct  $R_1$ . Primitively, it has a considerable number of crowded anterior rami and a distinct separation between these and the apical rami. In the advanced types there is less crowding and better differentiation, resembling the condition found in the Blattidae. To some extent the primitive condition is reminiscent of that found in the Panesthiidae. The radial sector primitively has a number of apical rami and posteriorly directed branches. These latter shift forward in higher forms and pass to the apex, comparable to the condition found in the basic Blattinae and Blaberinae. The freely branching media primitively has three or more posteriorly directed branches, but soon these pass to the apical margin as in the other Blattaria. In the higher Polyphagidae it is represented by a single branched vein, always distinct from the cubitus as in some of the epilamproids. Cubitus may show a division into two stems as in many of the Blattidae or may be reduced. This vein shows various developments in some of the subfamilies. Its sectors are at least arcuate and in general go to the postero-apical angle as in the Blattinae, but do not tend to parallel the posterior margin as in many of the higher Blattaria. The plical furrow is well indicated, definitely angulate in the primitive forms, resembling the condition found in the Perisphaerini. The more

advanced types have it evenly arcuate as in most of the Blattidae except the pseudomopoids. The strength of the arcuation is in part characteristic of some of the subdivisions. In at least some cases, the first plical (CuP) is evident in the furrow and its basal connection with cubitus can be ascertained. However, this is not true of the more specialized forms. The anal area approximates in length the subcosta as in the Blattidae, not longer as in the Panesthiidae. The anal veins show more evidence of branching in the anterior portion of this field than in most forms. In general, the veins curve toward the apical corner as in the Nyctiborinae and Blaberinae.

The wings have a distinctive shape, the large preaxillary area and small unfolded anal lobe which will separate them from all other Blattaria. Also, the short plical fold, usually one-half or less of the wing length, as opposed to being almost equal to the wing length in all the other forms. The anterior margin varies from straight through weakly arcuate to weakly biconvex. The apical margin is either broadly or narrowly rounded and passes into the arcuate posterior margin. A definite and decided notch is always noticeable at the margin of the plical fold. The margin of the anal field is usually regularly and evenly arcuate.

The subcosta which is relatively long but not distinctive may have anterior rami, twiggings or not. This vein reaches the anterior margin beyond the basal third, often near the middle.  $R_1$  is longer and as a rule more nearly simple than in most of the Blattidae, much as in the Panesthiidae. In the primitive forms some indefinite, irregular anterior branches are present, while in some of the more specialized forms this vein is simple. In certain of the subsidiary groups rather definite and regular branching is found. The radial sector has both anterior and apical rami in the primitive genera and these are more distinct than in other Blattaria. Some advanced types approach conditions found in Blattidae. Specialization is carried on by (1) a reduction or loss in the number of anterior rami so that only the apical branches and branches of the radial sector are retained; (2) a reduction in the branches of the sector and a regular distribution of anterior rami; (3) the loss of the apical branches. Rarely some of the branches of the radial sector extend arcuato-sinuately to the wing apex. However, this seems to be merely a generic characteristic. The arculus is

strong, prominent and transverse. Media may apparently rise either from the arculus or be stalked on the radial system. In the former case, its origin may be at the top or in the middle of the arculus. The mode of origin of this vein is helpful in defining the subsidiary groups within this family. The media is strong, primitively with three or more definite and some indefinite basal accessory branches. In specialized forms, the accessory branches are lost and the number of major branches may be reduced to two; or in the extreme case of *Holocompsa* the media is an incomplete stub. The cubitus has a large and variable number of diagonal sectors all going toward, and most attaining, the apical margin, a condition not found elsewhere in the Blattaria. It occupies a larger area than any other system. An archdictyon is present at the base of cubitus as in the Brachycolinae and certain other primitive genera. The first plical vein primitively has terminal branches, but is simple in higher forms, in the latter being comparable to the condition found in other Blattaria. The second plical vein is normally simple and strong as in certain Nyctiborinae and Blaberinae. Rarely, it is sinuate and with adventitious branches. The third plical vein is well removed from the branched axillary as in the Blattinae, Nyctiborinae and pseudomopoids. At times, intercalated veins are found in the plical area. The first branched axillary has more subdivisions than in other Blattaria. Often in the primitive forms a second and third branched axillary are present, a condition not found in other Blattaria. Behind this, there are usually four or more simple anal veins, rarely branched, which join the basal bar, but are distinct from the attachment of the branched axillaries as in the Blattinae, Nyctiborinae and in certain other forms.

Although there is extreme sexual dimorphism in many of the members of this family, the females in those genera which possess wings show essentially the same characters as do the males except that in certain cases the tegmina have become thickened and leathery. In some genera such as *Corydia* this condition has been attained by both sexes. However, in a number of genera the females are completely apterous.

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Diagram 2.—Probable relationship of the components of the Polyphagidae.<sup>2</sup> From checking a series of other than wing characters during this survey, the same conclusions can be attained. Therefore, it is believed that this grouping is warranted and logical.

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<sup>2</sup> In the charts attempting to show relationship, a single line (—) is used between subfamilies and a double line (==) between tribes and their subfamily.

The family may be considered to have the following components:

Polyphaginae, with the tribes Polyphagini and Corydiini.

Tiviinae, with only the nominate group.

Latindiinae, with the tribes Latindiini and Compsodini.

Holocompsinae, with only the typical group.

Euthyrrhaphinae, with only the distinctive genus *Euthyrrhapha*.

*Tentative Key to the Subfamilies of the Polyphagidae*

(Alate Forms Only)

1. Practically no venation visible in tegmina; wings with a pseudostigma

EUTHYRRHAPHINAE

Venation evident in at least basal portion of tegmina; wings without a pseudostigma . . . . . 2

2. No venation in apical portion of tegmina; wings with  $R_1$  and media clubbed.

HOLOCOMPSINAE

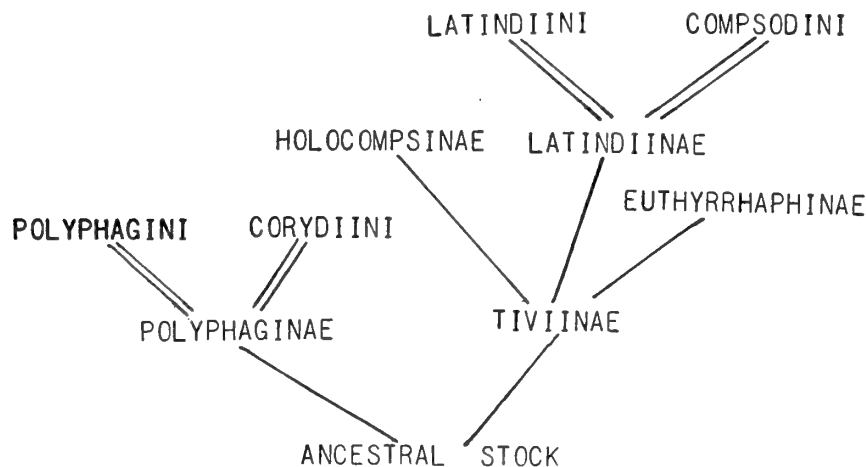
Venation throughout tegmina; wings without any clubbed veins . . . . . 3

3. Subcosta of tegmina with anterior rami; wings with more than one branched axillary . . . . . POLYPHAGINAE

Subcosta of tegmina without rami; wings with only one branched axillary . . 4

4. Radius of tegmina with regular apical branches;  $R_1$  of wings with regular apical branches . . . . . TIVIINAE

Radius of tegmina with at most a short simple apical posterior branch;  $R_1$  of wings either simple or bifurcate . . . . . LATINDIINAE



Explanation of diagram on opposite page.

## POLYPHAGINAE

The species of the typical subfamily, Polyphaginae, are all relatively large forms and may be distinguished from members of the other subfamilies by a combination of features. The tegmina have a moderate to ample humeral area resembling the Tiviinae, but not the other subfamilies, and the subcosta has at least some anterior rami while the related groups lack these. The anterior rami of  $R_1$  are not regularly spaced as in the other subfamilies and show some secondary branching; the remainder of the radial system is full and has numerous branches. It does not show any definite signs of reduction as in all others in the family. The media is strong, well developed, with three or more branches. Cubitus is rather full, much as in the Tiviinae, and the first plical vein (CuP) either shows a definite basal connection with the remainder of cubitus or approximates it. The plical furrow is relatively strong and distinctly arcuate.

The wings are relatively large, membranous and with the typical form for the family. They do not show any signs of specialization by reduction or simplification as do the wings of the other subfamilies, but retain an abundant, richly branched venation. Those genera showing reduction in wing size have retained the fundamental features of venation characteristic of this group. The anterior wing margin, except in those forms showing reduction, is relatively straight as in most members of the family. The subcosta may show some signs of twigging, but is usually simple. The first branch of radius may be simple, as in the Compsodini, or show a number of anterior rami that are generally irregular and incomplete. However, in the genus *Heterogamia* they are more regular, but never evenly spaced as in the Tiviinae. The radial sector is variable either with some anterior irregular rami and apical rami or with apical and posterior branches; always well developed but not appearing crowded toward anterior margin as in other subfamilies. Media is distinctive with three or more usually rather irregular branches except in those forms having reduced wings. The cubitus has a larger number of branches than in related forms, which vary from regular to rather irregular; some twigging usually is present in the basal area. The first plical vein normally has at least two apical branches and at times it is even further subdivided. This vein is simple in related forms. The third

plical vein is usually complete, but occasionally is rather indefinite and irregular. Some intercalated veins are often present in this area. The first branched axillary vein normally has a considerable number of branches which may be regular, although more often they are rather irregular or indefinite. In addition, there is at least one other branched vein in the anal fan, often two or more. In other subfamilies only one branched axillary is present, but in the Tiviinae terminal twigging is present in what would appear to be one of the other axillaries. In at least some cases, all the veins in the anal fan show definite branching.

This subfamily may be divided into two readily recognizable tribes: Polyphagini and Corydiini.

#### Polyphagini

In the Polyphagini the females are apterous, while in the Corydiini they are alate.

The males have a combination of features that substantiate the differences found in the females. The tegmina have the humeral area less developed and the rami of the subcosta are usually more irregular and more crowded than in the Corydiini. At least the apical posterior branches of radius, and usually other sectors as well, are directed apico-posteriorly instead of passing directly to the apical margin or curving anteriorly as in the Corydiini. Media often has its sectors sinuately, instead of arcuately, passing towards the apico-posterior angle; its base is often connected by branches anastomosing with cubitus instead of being free. The cubitus shows at least a slight indication of an arcuation or angulate curve away from the plical furrow, instead of more or less paralleling it as in the Corydiini. The joining of the first plical vein (CuP) with cubitus is evident in some members of the complex and has not been noted elsewhere.

In the wing,  $R_1$  usually shows some anterior rami. The radial sector may have posteriorly directed sectors or more numerous apical branches than the Corydiini. Media is variable from relatively simple as in the Corydiini, to multibranched, but rises from the top of the arculus. The cubitus is inclined to show more basal twigging than in the other tribe. The anal area usually has branched veins posterior to the branched axillaries, a condition not found in other groups except the Corydiini.

The tegmina of the male are always fully developed and membranous, at times thickened. The subcosta is sometimes thickened and usually has a number of irregular anterior rami. The radius normally has a number of irregular anterior rami, and a number of postero-apically directed rami from the radial sector; some of these latter having secondary branches. The media is full and has four or more sectors which pass arcuately and usually sinuately toward the postero-apical margin. The cubitus is well developed and usually has some incomplete anterior basal branches, often curving distinctly away from the plical furrow, so that an isolated sub-crescentic area is left without major venation. Usually a considerable number of more or less irregular branches are present, while in some cases the cubitus divides into two main stems each having secondary divisions. In at least some instances CuP is directly connected with cubitus, while in others the two are more or less approximate. The plical furrow is generally arcuate. An indefinite and irregular number of anal veins are present, some of these, particularly those in the anterior portion, show branching.

Wings of normal shape, and fully veined. The subcosta is relatively strong and either simple or with some anterior rami.  $R_1$  has anterior rami, either regular or irregular. The remainder of the radius has a number of apical sectors, these either irregular and with secondary branching or regular; rarely somewhat sinuate. Media rising from the top of the arculus, often with basal anterior adventitious branches some of which join the radial system. Media with at least three and usually more well-defined branches. Cubitus well developed, with a number of diagonal sectors, some showing secondary branching, in all cases with considerable twigging in the basal region. First plical vein strong and with some terminal branching. Second plical vein either strong and regular or with adventitious branches. Third plical vein usually strong and regular, but occasionally irregular. First branched axillary with a number of major branches, usually these showing some subdivision. Usually the second axillary shows some branching and the third axillary always shows distinct branching. The remainder of the anal veins may be either simple or branched.



Representatives figured: *Arenivaga bolliana* (Saussure) figs. 6, 76. [Det. Hebard, 1937.] This species is the genotype. Male. Brownsville, Texas.

*Eupolyphaga sinensis* (Walker), figs. 13, 77. [Det. Hebard.] This species is the genotype. Male. Ching-yang-fu, Kansu.

*Heterogamodes roseni* (Brancsik) figs. 7, 82. [Det. Chopard.] The genotype is *Heterogamia ursina* Burmeister, [= *Heterogamodes ursina* (Burmeister)]. Male. Buiram-Ali, Transcaspia. U.S.S.R.

*Polyphaga aegyptiaca* (Linnaeus) figs. 14, 81. [Det. Hebard, 1932.] This species is the genotype. Male. Zakaki, Cyprus.

### Corydiini

In this tribe which can only be compared with the Polyphagini, both sexes have at least the tegmina preserved; usually the wings are present, but they may be considerably reduced.

The tegmina vary from the normal for the group to somewhat reduced, obovate and densely coriaceous. This latter condition is first noticed in females, but is apparent in both sexes of certain genera. The humeral area is more developed than in the Polyphagini, and in those forms with coriaceous tegmina may be broadly expanded. The subcostal rami are usually more regular than in the other tribe and are never as crowded. The radius does not have posteriorly directed branches, most of them going to the anterior margin and some to the apical one, instead of curving posteriorly. Media has its base free and its branching is regular and direct as opposed to the conditions found in the Polyphagini. The cubitus does not curve as distinctly away from the plical furrow and CuP is never found joined to cubitus.

In the wing both subcosta and  $R_1$  are usually simple instead of with anterior rami as in the Polyphagini. In the radius the sectors go to the apex, instead of posteriorly, and usually have but little secondary branching. Media is either stalked on the radius or rises from the middle of the arculus as opposed to the condition found in the other tribe. Cubitus usually has less basal twigging than in the other tribe. There are always some simple anal veins.

In those forms with fully developed tegmina, the humeral area is moderately developed and the subcosta is usually strong and possesses a number of anterior rami. In forms showing reduction the humeral

area is broader and anterior rami, while present, are less strongly developed. A number of anterior rami are present in the radial system, these being longer and usually more regular than in the other tribe. Some of them show secondary branching. Apical rami are present, but no posterior branches are developed in this tribe. The media is well developed having at least four major branches, these often further subdividing. Cubitus is more or less regularly rounded along the plical furrow, not showing the sub-crescentic venation-free area. It possesses a number of branches, but does not show a basal division into two main stems. The plical furrow is regular and more or less evenly arcuate, not approximating the base of cubitus. In the more primitive forms, a number of anal veins are present; however, in the more specialized forms most of these are lost and only traces of two or three of these veins may be found.

The wings may be either reduced or not; those reduced in size have a corresponding reduction in venation. The subcosta is long, simple and straight, usually not reaching the costal margin.  $R_1$  is usually prominent, simple and not attaining the costal margin. The remainder of radius has some anterior and apical rami that are more or less irregular. No posterior rami are present. Media may be stalked basally with radius or rise from the middle of the arculus. It does not show any basal adventitious branches and has at most three relatively short branches with terminal twigging. In forms with reduced wings, it shows simplification. The cubitus has a number of sectors, usually more regular than in the other tribe. In the more primitive forms some basal twigging is noticed, but in the more advanced genera this tendency is lost. The first plical vein shows terminal twigging in the fully alate genera, but is simple in those showing reduction; the second and third plical veins are simple, strong and direct. In the fully alate forms, there are three branched axillary veins, while those showing reduction have at least one branched axillary, but the remainder may be reduced. There are always two or more simple anal veins.

Representatives figured: *Corydia petiveriana* (Linnaeus) fig. 8. [Det. Hebard.] This is the genotype. Male. Trichinopoly, Presidency Madras, India.

*Dyscologamia pilosa* (Walker) figs. 15, 16, 83, 87. [Det. Hebard, 1928.] The genotype is *Dyscologamia cesticulata* Saussure. Male. Grot by Baso, Sumatra. Female. Fort de Kock, Sumatra.

*Homoeogamia mexicana* (Burmeister) figs. 9, 78. [Det. Hebard.] This is the genotype. Male. Jalapa, V. C. Mexico.

#### TIVIINAE

This subfamily occupies an intermediate position between the generalized Polyphaginae and some of the more specialized members of the family. It might be characterized as showing a simplification by reduction of the basic type of venation, but not showing any other definite specialization.

The tegmina have a simple subcosta as in the advanced subfamilies, but the remainder of the tegmina are essentially like those of the Polyphaginae. The anterior radial rami are numerous as in the latter, but show the regular spacing of the Latindiinae. The radius has apical branches as in the Polyphaginae, but they are more regular than in that group. The media is sinuate as in the Polyphaginae, but has fewer branches, only two, and has not become as simplified as in the Latindiinae. Cubitus has a number of oblique branches, this again showing simplification from the primitive type, but not as advanced as the most specialized groups.

The wing shape is like that of the Polyphaginae. The subcosta is simple as in the Corydiini, but also is fused with the base of radius as in the Euthyrrhaphinae.  $R_1$  has regular anterior rami not as in the other tribes and the remainder of the radial system has simple apical branches, an intermediate condition. Media is two branched as in the Compsodini. The cubitus has rather regular oblique sectors, an intermediate condition for the family, and lacks the basal twigging found in most of the primitive forms. All the plical veins are simple as in the advanced subfamilies, and only one branched axillary is present.

The tegmina have a simple, but heavy subcosta. The radius has a number of regular anterior and apical rami and the apical posterior radial branch is present. Media, which at first closely approximates radius becomes free and has two complete simple branches. The cubitus has a number of diagonal regular sectors. The plical furrow is evenly arcuate. No veins can be found in the anal area.

The wing has a simple, direct subcosta and a four branched  $R_1$ , with its branches very regular and direct. The radial sector has a number of spaced, regular branches. Media rises from the middle, or a little above the middle, of the arculus and has two simple, direct branches. The cubitus has a number of regular sectors. All of the plical veins are present, complete and relatively strong, the first and second being somewhat sinuate. Between the third plical and the branched axillary is a series of intercalated veins. The branched axillary is moderately developed and has four main branches. The remainder of the anal veins are simple except for a slight tendency to terminal twigging.

From this complex apparently has been derived the three specialized subfamilies, Latindiinae, Holocompsinae and Euthyrrhaphinae.

Only the genus *Tivia* is placed in this subfamily.

Representative figured: *Tivia termes* (Karny) figs. 10, 85. [Det. J. A. G. Rehn, 1933.] The genotype is *Tivia simulatrix* Walker. Male. Vryburg, British Bechuanaland, South Africa.

#### LATINDIINAE

This subfamily consists of a specialized assemblage that has apparently developed from the Tiviinae. The extreme specialization of the tegmina reminds one of the condition found elsewhere only in *Ceuthobia*, but this resemblance is purely superficial. The wing is definitely polyphagoid.

The tegmina may be compared with the Tiviinae from which they differ by having radius with anterior rami and at most a short simple apical posterior branch instead of having regular apical branches and a long apical posterior branch. Media more nearly parallels the radius, than in the other group and the cubitus has fewer and more regularly spaced branches which go to the posterior margin instead of to the apical margin and apico-posterior angle. The plical furrow is less arcuate than in the Tiviinae. These forms have the subcosta and radius basad much as in the Holocompsinae, but the lack of a complete vein system separates this latter group.

The wings are best compared with those of the Tiviinae, but show some relationship to the Euthyrrhaphinae. The subcosta is simple as in these groups, but differs by not being stalked on the radius.  $R_1$  is either simple or bifurcate, thus differing from the con-

dition found in either of these groups, and the remainder of radius has only anterior rami, another distinctive feature. The media is either two branched as in the Tiviinae or simple. The cubitus has fewer, at most five, regularly spaced, arcuate branches; none are secondarily branched as in the other groups. The plical veins are simple as in all the higher Polyphagidae. The axillary is either simple or with one branch, a condition not found elsewhere in the family except in the highly modified Holocompsinae.

The tegmina, while of normal shape and membranous texture, do not resemble those of any of the other subfamilies. The subcosta is simple, straight and unbranched. The radius is but moderately well developed having a number of more or less regular, simple anterior rami. The radial sector is either greatly reduced and not branched, or not differentiated. The media is relatively strong and has two or three simple branches, these ending at the tegminal apex. The cubitus is somewhat reduced, the branches are moderately regular and vary from three to ten; secondary branching is found. The plical furrow is indicated, but is less strongly arcuate than in most members of the family. The anal field either lacks evident venation or has only three or four unbranched veins. An irregular network of large cells is made by the crossveins giving the tegmina an entirely different appearance from that of the other members of the family, and most other Blattaria.

The wings have the characteristic shape for the family and show specialization by a reduction in the venation, however, this is not as extreme as in the Holocompsinae. The subcosta is simple, free and direct.  $R_1$  is either simple and direct or with an apical branch. The radial sector has a fairly large number of anterior rami, rarely some of these showing branching; no true apical or apical posterior sectors are present. The media rises at the top of the arculus and is simple, showing at most a division into two main branches. The cubitus is prominent, but has only four or five simple, spaced, arcuate sectors. The first plical vein is free, complete and direct. The second plical vein is complete and from weakly to strongly sigmoid. The third plical vein is free and complete. The first axillary vein may have one major branch or may be simple. When it has any branches, secondary twigging may also be present.

This subfamily may be divided into the two tribes, Latindiini and Compsodini. These two specialized groups although evidently rising from a common type are readily separated. In the Latindiini, the tegmina have the subcosta free from the radial system, media is stalked basally on cubitus and shows but two branches, the cubital fan is rather well developed, and no veins are evident in anal fan. On the other hand, the Compsodini have the radius stalked on subcosta, media, which has three branches, free basally from cubitus, the cubital fan is somewhat reduced, and three anal veins are evident. The wings of the Latindiini have a simple media, a more fully developed cubitus, a less strongly sigmoid second plical, and they retain a branched axillary. The wings of the Compsodini retain a branched media, the cubital fan is more reduced; and the second plical vein is strongly sinuate. No branching is evident in the axillary area.

#### Latindiini

The tegmina of this group have the normal shape for the family, but have highly specialized venation. The subcosta is simple, strong, and free. The radius has a number of more or less regularly spaced anterior rami, and the radial sector is not evident. Basally, media is stalked on cubitus and after becoming free passes to beyond the apical fifth before dividing into two simple branches. The cubitus after becoming free from media shows seven or eight more or less regular sectors. The plical furrow is evident, lowly arcuate. No veins are found in the anal field.

The wings show considerable reduction. The subcosta is simple and somewhat curved. The radius has a rather well developed  $R_1$  with one branch and the remainder of radius has a few weak anterior rami; no apical posterior sector is evident. Media rises from the top of the arculus and is a simple vein extending practically to the wing apex. Cubitus occupies most of the pre-axillary area and has five spaced, simple, arcuate sectors. The first plical vein is free and slightly curved; the second plical vein is complete and more strongly sigmoid; the third plical vein is simple and direct. The first axillary shows some branching; posterior to this there is only one simple anal vein.

In this tribe is placed only the typical genus.

Representative figured: *Latindia dohrniana* Saussure and Zehntner figs. 17, 80. [Det. Hebard, 1919.] *Latindia maurella* Stål is the genotype. Female. Trinidad River, Panama.

#### Compsodini

The tegmina have the usual form for the family, but show a high degree of specialization. Subcosta is heavy and is stalked basally with the radius; after becoming free, the latter, has a few anterior rami, and there is a short, simple, apical posterior sector. Media is relatively strong and in the apical half divides into three branches that go to the apex. Cubitus is but moderately developed and shows three oblique sectors. The plical furrow is evident and arcuate. The anal field has four simple, irregular veins.

The wing has a simple, direct subcosta.  $R_1$  is well developed and simple, and the remainder of radius has some sinuate anterior rami, apically one of these sub-dividing. No apical posterior sector is retained. Media rises at the top of the arculus and somewhat beyond the middle of the wing divides into two simple branches. The cubitus is moderately well developed with four simple, spaced, arcuate sectors. The first plical vein is straight, direct and complete; the second plical vein is simple and direct. The third plical vein is simple and direct. All of the veins posterior to this are simple and incomplete basally. No branched axillary is present.

Only the genus *Compsodes* is placed in this tribe.

Representative figured: *Compsodes delicatulus* (Saussure and Zehntner) figs. 18, 84. [Det. Hebard, 1916.] This species is the genotype. Male. Cacao, Trece Aguas, Guatemala.

#### HOLOCOMPSINAE

This subfamily represents an extreme development of the Polyphagidae and does not appear to be closely related to any other known group.

The lack of any venation in most of the apical portion of the tegmina is a unique condition. The basal portion with its simple subcosta and radius with rather regular anterior branches resembles the condition found in the Tiviinae and Latindiinae. Media and cubitus are apparently fused basally and are incomplete, again a distinctive feature. The plical furrow is definitely angulate as in some Polyphagini, while

the lack of venation in the anal field is a condition found in some other members of the family.

The wings are unique with their large apical expansion of  $R_1$  and media, which together form a pseudostigma. The general lack of venation except for the three complete plicals is also distinctive. The simple subcosta is found in most of the groups of the Polpyhagidae.

The tegmina while of normal form, and showing a simple or relatively simple subcosta, have all the other venation incomplete. There is a short series of anterior radial rami passing to the margin. A definite posterior apical sector is not present, as this system stops slightly beyond the mid-point of the tegmina. Both media and cubitus are fused basally and are reduced to short stubs, the remainder of these veins being completely lost. Although the plical furrow is present, no trace of venation may be found here or in the membranous anal field. The entire apical portion of the tegmina is membranous and wrinkled.

The wing shows one of the most extreme types of specialization encountered in the Blattaria. The form of the wing is polyphagoid but a little unusual for the group. The subcosta is short and simple. The radius separates into  $R_1$  and a radial sector; the former soon thickens and forms a large terminal club occupying an area about one-sixth the length of the costal margin, while the radial sector ends abruptly as an incomplete stub. Media rises from the middle of a definite arculus and soon curves forward and forms a large club, this club having an area equal to about twice that of the radial club. Cubitus is present basally and ends abruptly as a bifurcating stub. The three plical veins are all complete, strong and very prominent. A trace of a single anal vein is evident. The remainder of the wing is membranous and somewhat wrinkled.

Only the typical genus *Holocompsa* is placed in this group.

Representative figured: *Holocompsa nitidula* (Fabricius) figs. 11, 79. [Det. Hebard.] This species is the genotype. Male. Lares, Puerto Rico.

#### EUTHYRRHAPHINAE

This subfamily is another of the varied polyphagoid lines of development and would appear to be most closely related to the Tiviinae.



The tegmina lack practically all venation, so that their relationship cannot be ascertained. However, the tegmina are broader basally than in most members of the family.

The wings have a shape between that of the Tiviinae and the Holocompsinae, the plical notch being less evident than is usual for the family. The subcosta is simple and fused basally with the radius as in the Tiviinae.  $R_1$  is present; beyond this there is a well-developed pseudostigma that obscures the details of the branching of radius. While this superficially resembles the condition found in the Holocompsinae, it is of different origin. Beyond this are a number of regular apical branches, much as in the Tiviinae. The media has three well-developed branches, more than in the Tiviinae or other advanced subfamilies, and is more regular than that in the Polyphaginae. The cubitus has a number of arcuate sectors, the most basal of which shows secondary branching and twigging as in some of the Polyphaginae. The plical veins and branched axillary are much as in the Tiviinae, except that the latter fills over one half of the anal field instead of about one third.

The tegmina are somewhat broader basally than is the norm in this complex. The anterior margin is weakly arcuate, the apical margin broadly rounded and the posterior margin weakly arcuate. Traces of subcosta and the radial stem are the only venation visible in the densely coriaceous tegmina. Both of these veins are represented by relatively short, incomplete, unbranching stems. A sinuate line apparently marks the plical furrow.

The wing form is slightly unusual for the family in that the plical notch is scarcely evident. The subcosta is fused basally with radius and is relatively short, simple and uncurved. The radial system has one anterior branch ( $R_1$ ) and then is obscured by a pseudostigma; beyond this four branches are present. The media rises from about the middle of the well-defined arculus and has three major branches, one of these being subdivided; all extend to the extreme wing apex. The cubitus is only moderately simplified having eight primary sectors which pass diagonally to the wing margins, the most basal showing a secondary division, and also some twigging towards the plical area. The first plical vein is unbranched and somewhat sigmoid. The second plical and third plical veins are entire, strong and direct. Between

these veins, and between them and the associated veins, are single intercalated veins. The first branched axillary is strong and occupies more than one-half of the anal fan, having five major and some secondary branches. Intercalated veins are present in this area. The remaining anal veins are simple and incomplete basally.

Only the typical genus is placed in this subfamily.

Representative figured: *Euthyrrhapha pacifica* (Coquebert) figs. 12, 86. [Det. Hebard, 1920.] This species is the genotype. Male. Mañaos, Brazil.

### DIPLOPTERIDAE

The distinctive genus *Diploptera* must be placed in a separate family. The densely coriaceous tegmina which lack distinct venation, appear superficially to resemble beetle elytra. The very unusual, highly specialized, wing with its major venation crossing the transverse fold readily separates this form from any of the other members of the Blattaria.

The venation of the tegmina, which is for the most part indicated by clear areas between rows of punctae, is of a simplified type. The very long subcosta, passing to the apical third is distinctive. The radius with its simple  $R_1$  and anterior rami and lack of an apical posterior sector is comparable to the condition found in some of the higher Polyphagidae and Blattidae. A single branched media occurs in several groups, and the extreme simplification of cubitus, a single stem, parallels the condition found in the higher Pseudomopinae and their related forms with appendiculate fields in the wings. The elongate anal area, set off by a straight plical furrow, is reminiscent of the condition found in the Panesthiidae.

The wings, with the transverse fold crossing the major venation, and the division of the radial sector into two simple veins are conditions not found in other Blattaria. The third plical vein supports approximately one-half of the appendiculate field. In all other forms with venation in the appendiculate field, such as the Ectobiinae and Anaplectinae, the third plical is solely responsible for its support. However, this vein being free basally from the branched axillary is a condition found in many of the primitive Blattidae. The radius dividing into a distinct  $R_1$  and  $R_s$  and the second plical vein terminating

apically in the first, are conditions found in various groups. The simple media that is somewhat stalked basally is a feature also found in the Epilamprinae and other groups. The reduction of cubitus to a two-branched vein with these branches attempting to reach the apical margin resembles the condition found in the Pseudomopinae. Thus, although showing relationship with various subfamilies of the Blattidae, *Diploptera* presents a combination of features not found in any one of the stocks.

The tegmina are relatively broad, the anterior margin basally being strongly convex, then almost straight and roundly passing into the apical portion. Instead of having the anterio-apical margin the most produced portion, this arcuately extends to the postero-lateral angle which is most produced and is the extreme apex of the tegmina. This angle is roundly rectangulate. The posterior margin is nearly straight and passes roundly into the short basal margin. Due to the texture, very little venation can be seen. The subcosta is heavy and in the basal sixth angles towards the costal margin, then parallels this margin for a distance equal to about one-half the total length; no branches or rami are present.  $R_1$  is short, almost parallel to subcosta to the point where the latter starts to parallel the margin. The radius has at most three simple anterior rami that go diagonally toward the margin; no apical posterior branch is present. Media parallels radius to about the midpoint and then forks into two simple branches, the anterior of which goes to the apex. The cubitus is a single vein roughly paralleling media and its posterior branch. The plical furrow is indicated by a straight line passing diagonally across the posterior portion of the tegmina and reaching the margin slightly beyond the end of the subcosta. Traces of four or five incomplete anal veins are present.

The wings are of very unusual type, and there is some question about the interpretation here used. The anterior margin is weakly arcuate, with a shallow notch at about the middle, this denoting the transverse fold; the apex is sub-rectangulate, with margins weakly arcuate; posterior margin gradually arcuate to a line behind the costal notch, which delimits the transverse fold; margin of anal field evenly arcuate. The subcosta is simple, extending almost to the transverse fold. Radius with  $R_1$  distinct, ending in two or more terminal rami slightly before the transverse fold. The radial sector is prominent,

forking before the transverse fold and continuing almost to the extreme apex as two simple branches. The arculus is strong, diagonal. The media is stalked basally for a short distance on radius: upcurved slightly before transverse fold, passing over fold and extending almost to the apex. The post transverse fold portion is rather strongly sigmoid. The cubitus is strong, almost straight to the transverse fold, there branching into two simple sectors, one of which extends practically to the apex, the other ending short of this. The first plical vein is weakly sigmoid to the transverse fold, passing this fold and ending slightly before the middle of the appendiculate field. The second plical vein is relatively strong in its basal one-half and apparently joins the first plical at the transverse fold. Third plical vein is simple in the basal half, beyond the transverse fold dividing into two main branches. The branched axillary has two or three simple branches, remaining ten anal veins simple.

This wing is folded in the following manner: the anal area folds fanlike, then the wing folds along the area between the second and third plical veins. Following this it folds transversely at the middle with the appendiculate field lying on top of the wing base in repose.

The wing is divided into a considerable number of cells, by the many cross veins; these are for the most part more or less regular except in the posterior half of the appendiculate field, where they are irregular.

This family contains only the nominate genus *Diploptera*.

Representative figured: *Diploptera dytiscoides* (Serville) figs. 20, 92. [Det. Hebard.] This is the genotype. Male. Honolulu, Hawaii.

#### PANESTHIIDAE

The Panesthiidae are another distinctive family, but they are more closely related to the Blattidae than to the other Blattaria. The tegmina are long and relatively slender, in texture somewhat resembling those of the Polyphagidae, but lacking their characteristic venation. The short, heavy, sigmoid subcosta is reminiscent of the condition found in the Paranauphoetini and some Pseudomopinae, but in contrast to the latter it is equal to one-half or less of the length of the anal field. The extremely elongate anal field is unusual but is also found in

the Diplopteridae, Oulopterygidae and certain Blattidae. The radial system, which has anterior and apical rami, is moderately crowded much as in some of the primitive Blattidae, particularly the Blaberinae. The retention of a branched media, a primitive feature, is shared with such forms as the Blattinae. Cubitus is also of a rather primitive type.

The wings are distinctive in that the radial system does not have more than five branches. This is an unusual condition for the Blattaria and a tendency towards it is normally achieved only by extreme specialization. The lack of a definite arculus in some genera is also distinctive. On the other hand, the rather long and simple subcosta is reminiscent of the epilamproids as is also the development of cubitus. In all forms studied, at least half of the branches of cubitus go to the plical fold. This is comparable to the condition found in the Epilamprinae. The media is usually simple as in many of the Blattidae. In this small family, the second plical vein varies from almost complete to relatively long and terminating in the first plical vein. This is comparable to the wide variety of conditions found in various subfamilies of the Blattidae. The third plical vein normally rises from the branched axillary, a condition noted in many of the Epilamprinae and some of the other more specialized groups. The relatively large number of regular anal veins, in most of the forms, is distinctive. Thus, the family shows a relationship to many of the larger entities of the Blattidae.

The tegmina are relatively long and narrow and are usually somewhat membranous; basally they may become somewhat thickened. The anterior margin is decidedly sinuate. The apical margin is usually broadly rounded, but at times is subtruncate. The posterior margin is evenly arcuate, usually with a notch or slight indentation at the plical furrow. The margin of the anal field is evenly arcuate. The humeral area is well developed. The subcosta is heavy and short, usually reaching the margin at the basal fourth. This vein is strongly sinuate and it is always unbranched. Ventrally it is often produced to form a tegminal catch. The radius is usually crowded towards the anterior margin;  $R_1$  is not differentiated, and the anterior rami are usually irregular. Near the antero-apical angle, some rami have secondary branches. The apical posterior radial branch is well developed, at times with accessory branches. The media is strong and has two

simple branches. The cubitus has its sectors well developed, but variable; considerable secondary branching is noticed as well as some basal twigging. In general the branches go toward the postero-apical angle. The plical furrow is distinct, strong, lowly arcuate. This furrow marks off the anal area which is equal to at least twice the length of the subcosta. The anal field has an indefinite and irregular arrangement of veins, some showing secondary branching; all are more or less parallel to the plical furrow.

The wings have the preaxillary portion rather large, and the anal area is full. The apical margin is either rounded or subtruncate. A definite plical notch is present, anal area with its margin broadly and evenly arcuate. The subcosta is straight and simple, extending for at least one-half of the wing length. The radial system with  $R_1$  distinct from the sector and extending almost to the apex, always simple. Radial sector extending for some distance before branching; never dividing into more than four branches, these may show terminal twigging. The apical posterior branch is very long and simple. All these branches end at the wing apex. An arculus may or may not be present. Media, which is usually stalked on the radial sector, is a simple, direct vein straight to somewhat sigmoid, rarely showing terminal twigging. The cubitus is strong and has eight or more sectors, at least one-half of these going to the plical fold or fusing apically and forming an accessory vein parallel to the first plical and the remainder going to the wing apex. The first plical vein is strong and complete, at times fusing apically with one of the cubital rami. The second plical vein varies from almost complete and free, to relatively long and with its apex approximate to the first plical. The third plical vein is stalked basally on the branched axillary, and its free portion is complete and simple, reaching the margin behind the plical notch. The branched axillary normally has two or three well-defined, simple branches. Behind this there are nine simple anal veins. Intercalated veins may be present between the major veins, posterior to  $R_1$ .

This family has only one apparent line of venational development. Therefore, the forms studied are all placed in the typical subfamily.

In addition to the typical genus *Panesthia*, there is at least, the genus, *Salganca*.

Representatives figured: *Panesthia angustipennis* (Illiger) figs. 25, 88. [Det. Saussure.] This species is the genotype. Male. Java. *Salganea morio* (Burmeister) figs. 19, 89. [Det. Hebard, 1932.] This species is the genotype. Female. Darjiling District, Himalayas.

### BLATTIDAE

The Blattidae are the largest and most varied of the families included in the Blattaria. In some respects, primitive venational types are included within this family as well as a number of highly specialized types.

The members of this family can be distinguished from most of the other families by their method of wing folding and support. The anal area is folded fanwise as in all the families except the Polyphagidae. When an appendiculate field is present, only in some of the advanced subfamilies, the field is supported only by the third plical vein; thus the area is not veinless as in the Oulopterygidae or supported by full venation as in the Diplopteridae.

The tegmina vary considerably in form and venation, but are never as densely coriaceous as in the Diplopteridae, nor are they as a rule as membranous as in the primitive polyphagoids. They usually do not have as proportionately a long anal area as the Panesthiidae and Diplopteridae. At times, they more or less resemble those of *Oulopteryx* in shape and texture, but they never have a subdiamond shaped area without venation between the radius and media, in the apical one-half, nor do they normally have a relatively broad area without venation between the cubitus and the plical furrow. Only the Ceuthobiinae have the tegmina as membranous as some Polyphagidae and the wing form will immediately separate these two groups. Those Polyphagidae with coriaceous tegmina normally have the subcosta much more extensive than in the present family. The venation varies considerably but forms with a short subcosta reminiscent of the Panesthiidae, have this vein equal to more than one-half the length of the anal field. In this family the anal field is usually either arcuate or angulate apically, instead of being lanceolate. The radial system is crowded anteriorly, much as in some Polyphagidae, only in some Nyctiborinae and Blaberinae. These groups may readily be separated from that family by a number of features.

The wings of the Blattidae may immediately be separated from those of the Polyphagidae by their shape, having an anal area normally as large as or larger than the preaxillary area. The length of the plical fold in the Blattidae approximates the wing length, except in some of those forms with an appendiculate field, while in the Polyphagidae it is never more than half this length. The Polyphagidae never have an appendiculate field and the other families that do, Diplopteridae and Oulopterygidae, either have all major elements of the venation crossing the transverse fold or else lack venation, while in the Blattidae this field is always supported only by the third plical vein. All the Blattidae have a definite arculus, which is lacking in some of the Panesthiidae. The plical veins vary in completeness, but the second one is rarely complete, and none show terminal twigging, both of which conditions are found in many Polyphagidae. The venation in this family as a whole is so variable that further comparisons can be made only within the various entities.

This differential diagnosis should serve to distinguish the Blattidae from the other families of the Blattaria. They represent a diversified group for which it is not possible to prepare a concise characterization. However, the various subsidiary groups may be moderately well defined and their relationships established.

The Blattidae is divided into nine subfamilies which apparently belong to four major lines of development. The basic Blattinae and the Nyctiborinae each appear to represent distinct stocks. The Brachycolinae, Blaberinae and Epilamprinae would seem to be derived from the same basic complex. The remaining subfamilies, Pseudomopinae, Ectobiinae, Anaplectinae and Ceuthobiinae are also apparently derived from a common ancestral form.

*Tentative Key to the Subfamilies<sup>3</sup> of the Blattidae*  
(Alate Forms Only)

1. Wings with apical portion marked off by a transverse fold ..... 2  
    Wings without a distinct apical portion marked off by a transverse fold .. 3
2. Tegmina with subcosta simple; wings without an apical posterior radial branch, apices of major veins joined before the transverse fold.  
    ECTOBIINAE
- Tegmina with subcosta with anterior rami; wings with an apical posterior radial branch, apices of major veins not joined ..... ANAPLECTINAE

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<sup>3</sup> The Nocticolinae and Archiblattinae are not included in this key.



3. Venation of both tegmina and wings amorphous, the determination of major veins being impossible ..... BRACHYCOLINAE  
Venation of both tegmina and wings of more usual type, determination of major veins and their branches possible ..... 4
4. Tegmina with radial system crowded anteriorly, all rami ending at anterior margin, media either with its branches occupying all or almost all of the apical margin or they end at anterior margin and cubitus occupies the apical margin ..... 5  
Tegmina with radial system usually normal, or if crowded anteriorly some of its branches or rami end at the apical margin, media with its branches occupying only a portion of the apical margin ..... 6
5. Subcosta of tegmina simple, media ending at anterior margin.  
PSEUDOMOPINAE (part)  
EUSTEGASTINI  
Subcosta of tegmina with anterior rami and a posterior branch, media occupying most of the apical margin ..... NYCTIBORINAE
6. Third plical vein distinct from the branched axillary and usually remote from it ..... 7  
Third plical vein stalked, at least basally, on the branched axillary.  
EPILAMPINAE (part)
7. All or almost all of the cubital branches of the wings going to, or curving toward, the margin ..... 8  
Numerous cubital branches of the wings going to or ending at the plical fold ..... 10
8. Cubitus of wings simple, unbranched; margin of area bounding the branched axillary expanded, practically equal to the preaxillary lobe.  
CEUTHOBINAE  
Cubitus of wings with at least one branch; margin of area bounding the branched axillary not greatly expanded ..... 9
9. Wings with media simple, or at most with a single apparently adventitious branch near the apex; usually all major cubital branches reaching the margin, rarely most basal branch not reaching this margin (Parco-blattini) ..... PSEUDOMOPINAE (part)  
Wings, when not reduced, with the media branched; some cubital branches not attaining the margin ..... BLATTINAE
10. Subcosta of tegmina always considerably longer than anal area, always with anterior rami and a posterior branch; wings with accessory veins in the base of the plical area, radius appearing to be crowded toward the antero-apical angle ..... BLABERINAE  
Subcosta of tegmina shorter than, to slightly longer than, anal area, with or without anterior rami and but rarely with a posterior branch; wings without accessory veins in the base of the plical area, radius not appearing to be crowded toward the antero-apical angle ..... 11

11. Subcosta of tegmina with a few short anterior rami apically, no posterior apical radial branch, media four branched; wings with a small interplical field, second plical vein ending free .... PSEUDOMOPINAE (part)

ISCHNOPTERINI

Without this combination of features ..... EPILAMPRINAE (part)

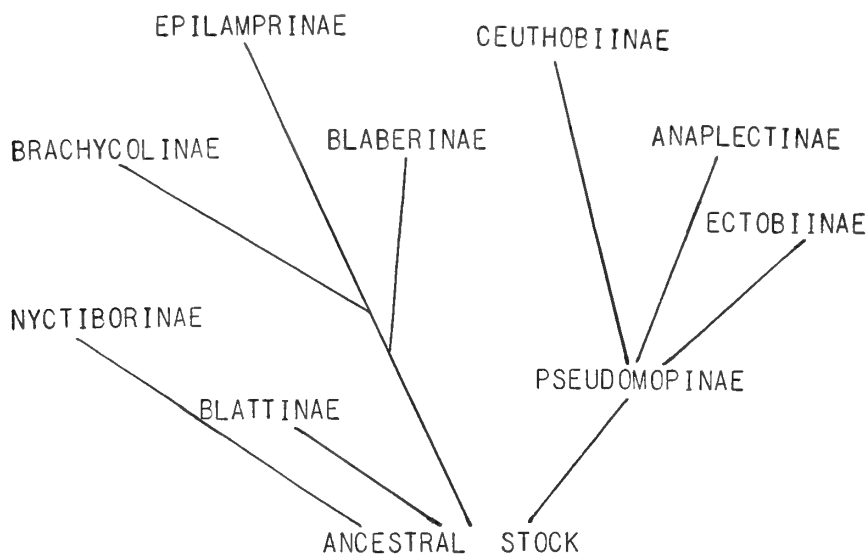


Diagram 3.—Probable relationship of the components of the Blattidae.

As shown in the diagram, the Blattinae are considered to be the most primitive of the existing Blattidae with three major lines of development. The two which are composite have been termed, for the sake of convenience, the Epilamproid complex and Pseudomopoid complex.

#### BLATTINAE

The Blattinae are the most primitive of the components of the Blattidae. The tegmina usually have a moderately developed humeral area as in the pseudomopoids and some of the epilamproids. The subcosta is rather heavy and may have anterior rami as in the epilamproids and certain pseudomopoids, but never has the posterior branches found in some of the epilamproids and the Nyctiborinae. The radius has irregular anterior and apical rami much like those in the epilamproids and not as regular as those in the pseudomopoids. The media is

branched, always free from cubitus as in the epilamproids and the primitive pseudomopoids and not enormously developed as in the Nyctiborinae. The cubitus has some indication of two stems, its branches varying from oblique to tending to parallel the posterior margin, thus showing affinities with the pseudomopoids on one hand and the epilamproids on the other. The plical furrow is evenly arcuate and the anal veins are more or less transverse with some branching apically and posteriorly as in the epilamproids.

The wings never have an appendiculate field as in the Anaplectinae and Ectobiinae. The wings have the subcosta simple or with a terminal fork, relatively short as in the pseudomopoids. Radius is well developed with some anterior rami, but these are less regular than in the pseudomopoids and are more numerous than in the epilamproids. The branched media is much as in most epilamproids, not simple as in the pseudomopoids and Nyctiborinae. The second plical vein is usually relatively long and free apically thus like some epilamproids and some pseudomopoids, but never fused apically with the first plical as often happens in both of these groups. Usually, it is not as long as in the Nyctiborinae. The third plical vein is free and remote from the branched axillary as in the pseudomopoids and the Nyctiborinae. The branched axillary is relatively simple and remote from the anal veins as in both the pseudomopoids and the Nyctiborinae, thus it is markedly distinct from the anterior fan.

The tegmina, in general, are elongated oval except when reduced, either by truncation or to a lobiform flap, and even then retain most of the essential venation, but on a reduced scale. In texture they vary from membranous, transparent to somewhat coriaceous. The overlap is but weakly indicated and then only in the more highly evolved genera. The anterior margin is either practically straight or weakly convex, roundly passing into the usually arcuate apical margin. In forms showing reduction, the antero-apical angle is sub-rectangulate. Apical margin roundly passing into the convex posterior margin. The plical furrow may or may not be indicated by a shallow notch. Anal field margin arcuate and passing by an obtuse angulation into the basal margin. The humeral area is well developed, except in *Pseudodero-peltis*. The subcosta is usually heavy, either moderately sinuate or nearly straight, reaching the anterior margin at or near its greatest

anterior expanse, and about as far apically as the end of the plical furrow. It is reduced in genera showing tegminal reduction. Some irregular rami are present in the more primitive genera, but they are absent in the more evolved forms. The radius is moderately well developed and has a number of anterior rami, probably including the undifferentiated  $R_1$ , some simple, others with more or less irregular secondary branches. Apically these branches tend to be dichotomous. The radial sector is usually well developed, with one or more branching anterior rami; an apical posterior sector is present, but often it is not well differentiated. The media is free basally and well developed, having four or more major branches, and with terminal subdivisions, except in those forms showing considerable reduction; often with additional incomplete basal branches. In some specialized genera media curves away from radius. The cubitus is well developed and usually has two main stems each with numerous supplementary divisions (branches). There are usually at least eight of these branches which in general go diagonally toward the apico-posterior angle. The plical furrow is distinct, usually gradually and variably curved to posterior margin. A plical notch may or may not be present. The anal field has a considerable number of veins which more or less parallel the posterior margin, some of the more posterior ones branched. Inter-calated veins are present in the vicinity of the radial sector, and in the median and cubital fields, except in genera showing considerable reduction.

The wings have a relatively large preaxillary area and a well-developed, but considerably shorter anal area. The anterior margin varies from straight to moderately convex and the apical margin is broadly and relatively evenly rounded, except in those forms showing reduction. A definite notch is present at the plical fold even in genera showing reduction. The margin of the anal field is arcuate, roundly passing into the basal margin. The subcosta is simple, straight to slightly curved and extends from one-third to one-half the wing length, except in the genus *Pseudoderopeltis* where it is shorter.  $R_1$  primitively has four or more rami, but a reduction occurs and some genera have this vein unbranched. Radius has relatively numerous anterior and apical rami, the more apical ones often subdividing. An apical posterior sector is present and often has a few branches. In forms

having reduction, it may not be distinctly differentiated. Media is primitively branched and free, rising from the apparent top of the arcus, but in the more advanced forms becomes stalked on the radius. The details of branching vary, but all genera not having marked reduction have at least two major branches and these usually subdivide. The arcus is strong, relatively prominent, and usually oblique. The cubitus usually has about seven main branches with numerous secondary divisions which go towards the apical margin. There is a marked tendency for these branches to fuse apically, in some cases basally; or median anastomosis may occur. The area below the arcus is free of basal twiggings. The first plical vein is free, simple and complete; apically it is either straight or curved slightly forward. The second plical vein is free, simple and, from long and almost complete, to moderately short, but the apex is always free. The third plical vein is strong and complete; its origin is free from the branched axillary. The branched axillary is strong, its base free from the third plical, and distinct from that of the other veins and it has from four to six branches, some showing a secondary branching. The anal fan is well developed with eight to twelve veins, exclusive of the branched axillary. Rarely some of these may show secondary branching.

Intercalated veins are present in the median field, and throughout most of the cubital field, rarely, as in *Deropeltis*, they are present in the radial field. The male of *Blatta* having the wings reduced lacks these.

An examination of a limited number of genera of this subfamily shows a diversity in development. A more comprehensive survey will be necessary to determine whether or not tribes may be represented. Both *Periplaneta* and *Deropeltis* have a variety of primitive features, and it seems probable that *Blatta* and possibly *Eurycotis* have evolved from this same ancestral stock. On the other hand, *Pseudoderopeltis* in some respects appears moderately distinct.

Representatives figured: *Blatta orientalis* Linnaeus figs. 24, 29, 93. [Det. Hebard.] This species is the genotype. Male and Female. Bloomington, Indiana.

*Deropeltis erythrocephala* (Fabricius) figs. 26, 96. [Det. J. A. G. Rehn, 1920.] This species is the genotype. Male. Transvaal.

*Eurycotis floridana* (Walker) fig. 28. [Det. Hebard.] The genotype is *Polyzosteria rufovittata* Brunner [= *Eurycotis mysteca* (Saussure)]. Male. Biscayne Bay, Florida.

*Periplaneta americana* (Linnaeus) figs. 21, 94. [Det. Hebard.] This is the genotype. Female. Trichinopoly, Madras, India.

*Pseudoderopeltis brevicollis* (Serville) figs. 27, 95. [Det. J. A. G. Rehn, 1920.] The genotype is *Deropeltis antennata* Saussure [= *Pseudoderopeltis antennata* (Saussure)]. Male. Pretoria, Transvaal.

#### NYCTIBORINAE

The Nyctiborinae represent a distinct group of the family and appear to be related to all its other major components. The tegmina are relatively broad, richly veined and have a small anal area. They have a large humeral area, and the subcosta, with anterior rami and posterior branches is as in some of the epilamproids. The radial system has the rami more crowded and the whole system terminates at the anterior margin, a distinctive feature, as in all the other groups at least some part of this system attains the apical margin. In conjunction with this the media has been greatly developed, more so than in any other existing group, its numerous branches occupying all or almost all of the apical margin. The cubitus is inclined to divide into two stems and the sectors may be oblique and go toward the postero-apical angle or tend to parallel the posterior margin, thus agreeing in part with the Blattinae and also with the pseudomopoids. The plical furrow is evenly arcuate as in some of the Blattinae and in epilamproids, but marks off an anal area proportionately smaller than that usually found in any of the other groups. The veins in this area tend to follow the curve of the nearest margin, with those mesad more or less straight as in the epilamproids, or there may be some anterior branching reminiscent of the condition found in certain of the Polyphagidae.

The wings, which are richly veined, have a large preaxillary area and a shorter anal area, much as in the Blattinae. The subcosta is either long and almost simple or with a few rami, resembling both the Blattinae and epilamproids. The radius is well developed, with numerous anterior and apical rami and has a well-developed apical posterior branch thus resembling, but richer than, the Blattinae. The

media is simple as in the pseudomopoids and many epilamproids. Cubitus has most of its sectors going to the apex and the remainder to the plical fold, much as in the primitive epilamproids. The second plical vein varies from complete to long and free apically, in the former resembling the Polyphagidae and certain Blaberinae while in the latter it is but little longer than in the Blattinae. The third plical vein is remote from the branched axillary which is distinctly separated from the remaining anals, resembling the condition found in both the Blattinae and the pseudomopoids.

The tegmina are broadly ovate with the anterior margin convex, passing into the broadly rounded apical margin and roundly passing into the subtruncate posterior margin. The plical notch is not well developed. Margin of anal field at first weakly arcuate or subtruncate, angulately passing into the basal portion. The humeral area is broadly expanded. The subcosta is heavy and either straight or angulate, approximating in length the anal field, with numerous to abundant anterior rami, some of which secondarily branch. Posterior rami, representing captures from the radial system, prominent, subdivided. The radius has numerous to extremely numerous irregular anterior rami, many with secondary and further branching; apical rami subdividing even further. No well-differentiated apical posterior sector is present. All radial branches go to the anterior margin of tegmina. The media with its origin near radius, soon divides into a large number of sectors with numerous secondary and further branches. Posteriorly, it is practically impossible to differentiate media from cubitus, these branches filling all or nearly all of the apical margin. The base of cubitus is close to that of media; there are usually two major stems each with a number of branches which further subdivide. These numerous sectors are either oblique or tend to parallel the posterior margin. The plical furrow is strongly arcuate and the plical notch is poorly developed. The small anal area has numerous veins, some of which show branching.

Wings with the preaxillary area large and anal area relatively small. The subcosta is equal to one-half or less the wing length, usually with irregular branches. The radius with a distinct  $R_1$ , which after paralleling subcosta, has anterior rami. The remainder of the

radial system has numerous irregular, often secondarily branched anterior and apical rami. An apical posterior branch with secondary divisions is present. The media, which is stalked for a short distance on the radial sector, is a simple vein, with or without terminal twigging, straight or arcuate. The arculus is strong and oblique. The cubitus has a number of irregular sectors of which one-half or more, but usually two-thirds, go to the apical margin and the others to the plical fold. Many of these branches have irregular secondary divisions. Some basal twigging is present near the arculus. The first plical vein is free, distinct and straight. The second plical vein is free, distinct, either reaching wing apex or nearly so. The third plical vein is free, distinct, straight, passing to the margin at or behind the plical notch. The branched axillary is strong, free from, and curving away from, the third plical; usually, it has four major branches, and some irregular secondary branches. A large number of simple anal veins are posterior to, and free from, the axillary.

The members of this subfamily are readily divisible into two components, those related to the typical genus, *Nyctibora* and the unusual *Megaloblatta*. It is believed that those entities are sufficiently distinct to be considered tribes. The Nyctiborini have a much less branched venation than is found in the Megaloblattini. The former have the tegmina with the subcosta straight, and with only a moderate number of rami while in the latter, the subcosta is strongly angled and has abundant rami. In the Nyctiborini, the radius, media and cubitus have fewer branches and less subdividing than in the other tribe. Also, in the Megaloblattini the sectors of cubitus are oblique instead of paralleling the posterior margin. The wings present the same general features, fewer branches, and branching in the Nyctiborini. Intercalated veins are found only in the Megaloblattini.

#### Nyctiborini

The members of this complex may be separated from the Megaloblattini by the features already mentioned. In addition the tegmina have the humeral area more produced basally and its margin is definitely angulate instead of arcuate. The subcostal rami are few and terminal, not widespread. The posterior branches of subcosta are fewer and have only single dichotomous branching. There is much



less secondary division of the radial rami and the radius is more restricted in its area. Both media and cubitus are more regular in their branching and these attempt to parallel the posterior margin. The anal field shows very little branching and the veins tend to parallel the nearest margin.

The wing in this tribe has the anal area proportionately larger than in the Megaloblattini. The subcosta is more regular and the radius has fewer branches. The media is straight instead of arcuate and cubitus has considerably fewer and more regular sectors. The second plical vein is not complete. The branched axillary is not as remote from the third plical vein and does not show any secondary divisions. There are more simple anal veins than in the other tribe.

It does not appear to be necessary to further characterize this tribe, to which most of the members of the Nyctiborinae belong.

Representative figured: *Nyctibora noctivaga* Rehn figs. 22, 90. [Det. J. A. G. Rehn, 1920.] The genotype is *Nyctibora sericea* Burmeister. Male. Changuinola District, Panama.

#### Megaloblattini

This tribe which is formed for the nominate genus has the following distinctive features, in addition to those previously noted. The tegmina have the humeral area less expanded, and its margin is arcuate instead of angulate. The subcosta, which is angulate, has a full series of rami, some of which have secondary branches and the posterior branches are more numerous and less regular than in related forms. The radius, media and cubitus all are exceedingly branched and all of these have numerous subdivisions. The branches of cubitus are oblique instead of parallel to the posterior margin. The anal field has the veins in its anterior portion with a number of branches, much as in some Polyphagidae. The remainder of the veins are more or less oblique and show some branching. The anal field is proportionately smaller than in the Nyctiborini.

The wing, which has a complete series of intercalated veins, has the anal field proportionately smaller than in the other tribe. The radius is more irregular and has more numerous branches. Media is arcuate instead of straight. The cubitus shows more branching both primary and secondary and is more irregular. The second plical vein

is complete. The branched axillary is free, and relatively remote from the third plical vein; its branches have some secondary divisions.

Only the primitive genus *Megaloblatta* is placed in this tribe.

Representative figured: *Megaloblatta blaberoides* (Walker) figs. 23, 91. [Det. Hebard, 1919.] The genotype is *Megaloblatta peruviana* Dohrn. Male. Muzo, Boyacá, Colombia.

#### EPILAMPROID COMPLEX

The epilamproid complex includes three subfamilies, Brachycolinae, Blaberinae, Epilamprinae, all of which appear to have evolved from the Blattinae. Many have the humeral area of the tegmina developed as in the Nyctiborinae, while some retain this area much as in the Blattinae and in pseudomopoids. The subcosta, while primitively like that of the Blattinae, more often has numerous anterior rami and some members have acquired posterior branches as in the Nyctiborinae. The radius may be of the type found in the Blattinae, but often with irregular and oblique rami, and with terminal branches. The apical posterior branch is often well developed and with more branches than in the other groups. Primitively, there is a well-branched media as in the Blattinae, but in advanced forms it is reduced; rarely fused with cubitus, as in some members of the pseudomopoid complex, or tremendously developed as in the Nyctiborinae. Cubitus primitively with numerous branches, at times with two stems as in many Blattinae, the sectors mostly go toward the postero-apical angle. Advanced forms have fewer branches, but they rarely parallel the posterior margin as in many of the pseudomopoid complex. The plical furrow is evenly arcuate as in the Blattinae, not limiting a small anal area as in the Nyctiborinae or angulate as in many of the pseudomopoid complex. Anal veins normally tend, more than in the other groups, to parallel the furrow. They may be branched as in the Blattinae.

Wings with the subcosta longer than in the other groups, and often simple.  $R_1$  well differentiated, usually with more rami than in the pseudomopoids, much as in the Blattinae and Nyctiborinae. Radial sector with some anterior and apical rami, the apical posterior branch is often well developed, primitively as in the Blattinae, but the advanced forms show reduction. Media branched in Blaberinae, Brachycolinae and in some Epilamprinae, in others simple as is also the case in the

Perisphaerini. The former condition is comparable to that in the Blattinae, while the latter is like that in the pseudomopoid complex and the Nyctiborinae. The cubitus is primitively as in the Blattinae and Nyctiborinae with a few branches to the plical fold, specializing by having more branches to this fold until in the Thoracini all but the last two do not reach the wing apex. The first plical vein is usually straight as in the Blattinae, rarely curved forward as in the pseudomopoid complex. In some, it is fused with the coalesced tips of the cubital sectors, a condition practically distinctive of this group. The second plical vein varies from long to short and its apex may be free or not. In this some genera resemble the Blattinae and others some of the pseudomopoid complex, but in none is it as long as in the Nyctiborinae. The third plical vein is either free, or fused for a varying distance with the branched axillary, never free and remote from this vein as in the Blattinae, Nyctiborinae and the pseudomopoid complex. The branched axillary is either comparable in size to that of the Blattinae and of the pseudomopoid complex, or it may be more developed and support up to one-half of the anal field.

#### EPILAMPRINAE

The Epilamprinae is the largest and most varied in the complex and as here understood includes not only the Epilamprinae of authors, but also the Panchlorinae, and Perisphaerinae and certain other concepts which have been put in other subfamilies. This assemblage includes a number of diverse lines of specialization, but apparently is of homogenous origin. The diversity is such that a number of tribes must be recognized.

The tegmina may have the humeral area but moderately developed as in the Blattinae or it may be large, as in the other members of this complex. The development of the rami of subcosta indicates a similar relationship; posterior branches are also present at times, as in the Blaberinae. The radius has more branches and is more irregular than in the Blattinae, except in the Perisphaerini, somewhat as in the Blaberinae, although the field is not as broad as in that subfamily. The radius is not as irregular as in the Brachycolinae. Media is moderately branched as in the Blattinae, particularly in the Perisphaerini. It has fewer branches than in the Blaberinae, and only rarely is simple

as in some *Pseudomopinae*. The cubitus often has two main stems with secondary branches. These may be regular or irregular, and go obliquely to the postero-apical angle, agreeing in this respect with the *Blaberinae* and *Brachycolinae*. The more anterior anal veins tend to parallel the plical furrow, while the posterior ones are more or less transverse, resembling the condition found in the *Blattinae*.

Wings with the subcosta long and simple as in the other subfamilies.  $R_1$  about as in the *Blattinae* but longer, usually not as long as in the *Blaberinae*. The media is usually simple as in many other groups. Cubitus with at least one-half of its branches going to the plical fold, often more; this is practically distinctive. The second plical vein usually terminates in the first plical, not free as in the *Blaberinae* and *Brachycolinae*, but it is short in the *Perisphaerini*. The third plical vein is free or fused with the branched axillary, never remote as in the other groups. All members of the group with anterior branches from the branched axillary, and this vein is not remote from the remaining anal veins.

The tegmina vary from relatively short and broad to rather long and slender, however, they never approach the extreme condition found in certain *Blattinae* and *Panesthiidae*. The anterior margin is generally weakly convex, but varies from almost straight to sigmoid. The apical margin is usually broadly rounded, at times only narrowly so, rarely almost subrectangulate. The posterior margin varies from weakly arcuate to almost straight and a notch is usually present at the apex of the plical furrow. The margin of the anal field is occasionally subangulate basally. The humeral area is usually at least moderately well developed, in some genera it is greatly expanded; rarely it is reduced. This latter condition is found in some of the more specialized genera. The subcosta is strong, usually approximating in length the anal field, always with some anterior branches. Basally it is heavy and thickened, at times this tendency is noted in some of the anterior rami. Anterior rami normally rather irregular and numerous; rarely showing secondary branches, at times reduced. In at least some of the subdivisions posterior rami are present. Radius with at least a moderate number, often abundant, anterior rami; at times some of these stalked on the subcosta. These vary from very irregular and with secondary branches to regular, spaced and simple. In general, a tendency toward reduction and simplification of radius is noted in the more

advanced forms. Usually some apical rami, which may have secondary divisions, are present. An apical posterior radial branch is usually present although it is often poorly developed or not well differentiated. Rarely, the radius appears to be stalked with a portion of media. The media primitively has four regular branches which extend to the apex. However, there is a gradual reduction in branches as well as an approximation of the basal portion of media to the radius. In certain of the complexes, the base of media has become involved with that of cubitus so that they can not be separated. The cubitus primitively is rather irregular with numerous branches going diagonally to the postero-apical margin. The division of this vein into two stems is often evident. In more advanced members of the group certain tendencies are noted, one the addition and another the reduction in the number of cubital branches. In both of these cases branching is regular with little secondary division, and the branches tend to more or less parallel the posterior margin. When these conditions are found, the division into two main stems is usually not evident. The plical furrow is distinct, with at least a noticeable apical notch. This furrow is strongly to weakly arcuate, never distinctly angulate; usually, it more or less parallels the basal cubital branch. The anal area is broad and about as long as the subcosta. It has a moderate to large number of simple veins, which in general go arcuately across the field.

The wings show considerably more diversity than do the tegmina, although certain basic similarities exist among all the members of this subfamily. Certain distinctive venational features are taken as indicating tribal division. The anterior margin is usually evenly arcuate, rarely subsigmoid and the apical margin varies from broadly to rather narrowly rounded, rarely subtruncate. The plical notch is normally evident, at times strong, rarely subobsolete. Margin of anal field usually evenly and broadly arcuate, at times angulate basally. The anal field is large. The subcosta is always simple and more or less parallels the costal margin, usually ending past the midpoint, at times extending almost to the apical third. Radius with  $R_1$  always well differentiated and having anterior rami; these are irregular in some groups, but, usually, rather regular and rarely showing any secondary division. The remainder of radius parallels  $R_1$ , then has some anterior and apical rami; these are regular or irregular. Often there is

a short, simple apical posterior radial branch going to the apical margin, rarely directed obliquely posterior. The arculus is always strong, and usually oblique. The media normally apparently rises from the top or the middle of arculus, rarely stalked on radius. Usually it consists of a simple arcuate or sigmoid vein, at times having some terminal branching. The cubitus is strong and has a large number of oblique branches; usually more than half of these go to the plical area, while the remainder go to the apex. Although these are at times rather irregular, extreme regularity is found in most of the members of the group. The arrangement of these sectors is a distinctive feature of the group. The first plical vein is always simple and complete, at times slightly upcurved apically, not joining any of the cubital branches. The second plical vein varies from long and free apically to, in the majority of cases, short and terminating in the first plical. The third plical vein is often stalked upon the branched axillary and except in extreme modifications is straight and goes to the margin behind the plical notch. Usually at least ten veins are present in the anal area, varying from eight to more than sixteen. The branched axillary, which is sometimes fused basally with the third plical, normally has from two to five simple branches. It is not always possible to tell which is the most posterior branch of this vein because of the arrangement of other veins along the basal bar. Intercalated veins are always present in the anal area and may appear in the preaxillary portion.

This subfamily may be divided into the following tribes: Calolampirini, Epilamprini, Leucophaeini, Litopeltini, Nauphoetini, Oniscosomini, Panchlorini, Paranauphoetini, Paratropini, Perisphaerini, Phoraspidini and Thoracini.

#### Calolampirini

This small tribe has a combination of features that serve to separate it from related forms. As the organs studied are not fully developed in the female sex, the discussion concerns only males. The tegmina resemble in most respects those of the Oniscosomini. The simpler, heavier, and shorter subcosta which is considerably shorter than the anal area, will serve to distinguish this tribe. The branches of cubitus are more irregular than in any other tribe.

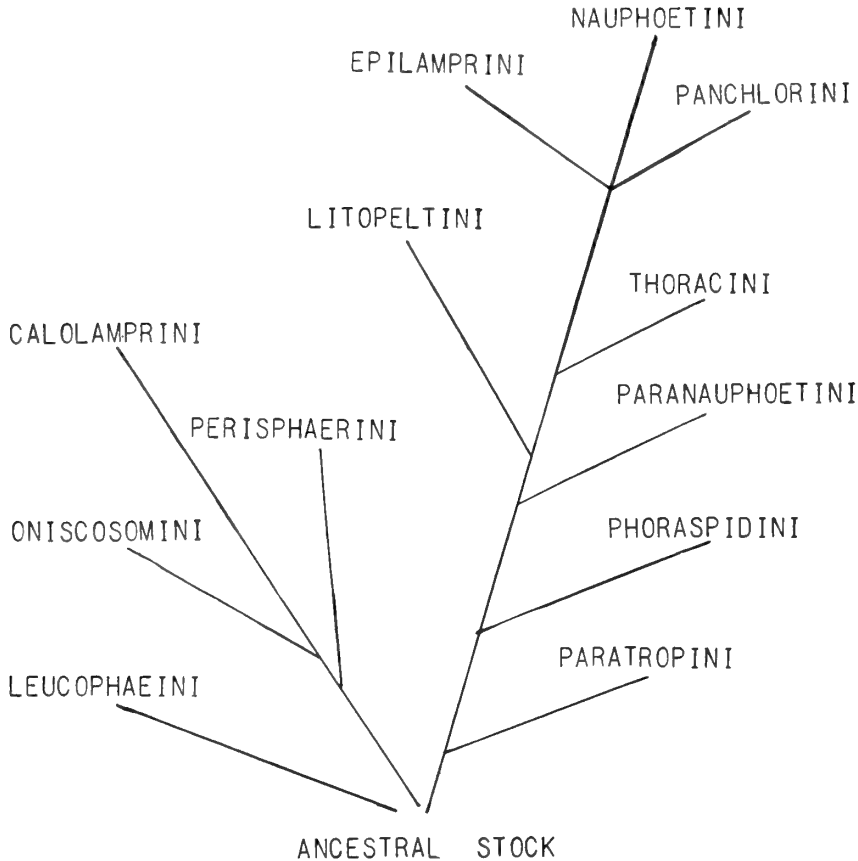


Diagram 4.—Probable relationship of the components of the Epilamprinae.

The wings are more like those of the Panchlorini, having the anal area more produced than in the Oniscosomini and Leucophaeini. The subcosta is shorter than in most of the other tribes.  $R_1$  has spaced anterior rami, and the cubitus has only about one-third of its branches going to the apex, as in many of the more highly evolved groups.

The tegmina are relatively broad with the apex evenly and broadly rounded, more so than in most of the other tribes. The subcosta which is equal to only about two-thirds the length of the anal field is very heavy and has only four spaced, simple anterior rami. The radius curves forward slightly before the middle. It has, basally,

regular anterior rami, then ones with secondary branching. Irregular apical branched rami are also present as is a short, simple, apical posterior branch. The media parallels radius and has at least three simple branches. These start near the middle of the tegmina, approximate to the forward curve of radius. The cubitus has several irregular, oblique branches. The plical furrow is arcuate, and a shallow plical notch is present. The anal field has a few veins, the more median of which branch.

The wings have a proportionately smaller preaxillary area than in the Oniscosomini and Leucophaeini. The anal field is fuller and more produced, projecting almost as far as the preaxillary portion, more as in the Phoraspidini and *Homalopteryx*. The subcosta is simple and shorter than in most other groups, reaching the anterior margin before the middle.  $R_1$  has only four regular anterior rami, much as in the Leucophaeini. The radius has a few apical rami and the apical posterior branch is not differentiated, which is unusual. The media is simple and arcuate. The cubitus has moderately regular oblique branches of which one-third go to the apical margin. The first plical vein is simple and direct, not upturned apically. The second plical vein is very short and ends in the first plical. The third plical vein is free from the branched axillary, simple and direct. No interplical field is present. The branched axillary has three simple branches and there are nine simple veins posterior to it. Intercalated veins are found in both the preaxillary area and the anal field.

At present only the typical genus is placed in this tribe.

Representative figured: *Calolampra irrorata* (Fabricius) figs. 30, 97. [Det. Saussure.] This species is the genotype. Male. "Nouveau Holland" [= Australia].

#### Oniscosomini

This distinctive tribe is apparently most closely related to the Leucophaeini and Calolamprini. As females of this tribe have the tegmina and wings markedly reduced the discussion is based on the condition found in the males. The amorphous venation of the tegmina is comparable only with that of the Calolamprini. The subcosta without a complete series of anterior rami, the freely branched media and the oblique cubital branches are all primitive features shared with some



of the other members of the subfamily. The anal field approximates in length the subcosta, which again is a primitive condition.

The wings have the anal area considerably shorter than the pre-axillary area, as in the *Leucophaeini*. The irregular venation is distinctive of this tribe. In general, there are fewer cubital branches than in the other tribes. The first plical vein is straight apically and no plical field is present, agreeing in these respects with some of the other tribes of the group. The branched axillary with the most anterior branch rising first is distinctive.

The tegmina vary from relatively broad to rather slender, rounded apically much as in the *Leucophaeini*, but less so than in most of the other members of the subfamily. The humeral area is moderately or distinctly produced. The subcosta is heavy basally as in the *Epilamprini* and *Leucophaeini*, and has a small number of irregular, and at times secondarily branched, anterior rami. These are absent basally and the most apical ones may be connected with some of the anterior radial rami. The radius has a number of irregular, secondarily dividing anterior rami and the irregular apical rami also have subdivisions. A distinct, simple, posterior branch is present, usually rising slightly past the middle. The media is more remote from the radius basally than in most members of the group, and it divides into three or more distinct branches, some of which have terminal subdivisions. The cubitus has a definite anterior branch as in the *Panchlorini* and some *Epilamprini*. The remainder divides into a number of regular sectors, some dividing secondarily; these go obliquely toward the postero-apical angle. The plical furrow is distinct and an apical notch is at least indicated. Although this furrow is close to the basal portion of cubitus the latter does not curve evenly around it as in certain of the other tribes, agreeing in this respect with the *Leucophaeini*. The anal area has a number of irregular veins the more median of which usually branch, as in several other tribes.

The wings have a large preaxillary area, a well-defined plical notch and an anal area proportionately smaller than in most of the other tribes. The subcosta is long, extending to almost the apical third, simple and direct. The radius divides into a distinct  $R_1$  which has some irregular terminal twigging, much as in some *Leucophaeini*. The remainder of radius is practically simple to below the apex of the

subcosta then it has some irregular apical rami. In the genus *Blaptica*, a definite posterior radial branch is present, while this is greatly reduced in *Oniscosoma*. The radius is often connected with  $R_1$  by some adventitious crossveins. The arculus is strong and diagonal. Media is either sinuate or arcuate and goes to the extreme apex; in *Oniscosoma*, it has simple terminal branches. The cubitus is strong and has a number of sectors, usually seven to ten, of which about one-half go to the apical margin, the remainder towards the plical furrow. At times their apices curve and join. The first plical vein is free and straight. The second plical vein is relatively short, equal to between one-third and one-half the wing length, and always ends in the first plical. The third plical vein may be stalked, at least for a short distance, on the branched axillary, and goes to the margin slightly behind the plical notch. The interplical area is not expanding. The branched axillary normally has three branches, the more anterior one rising first, which is distinctive of this tribe. Eight to ten simple anal veins are posterior to the branched axillary.

It is believed that a number of genera in addition to those studied belong to this tribe.

Representatives figured: *Blaptica dubia* (Serville) figs. 32, 99. [Det. Hebard, 1921.] The genotype is *Blaptica claraziana* Saussure = *Blabera dubia* Serville [= *Blaptica dubia* (Serville)]. Male. Buenos Aires, Argentina.

*Oniscosoma granicollis* (Saussure) figs. 31, 98. [Det. J. A. G. Rehn, 1922]. The genotype is *Oniscosoma castanea* Brunner = *Zetobora granicollis* Saussure = [*Oniscosoma granicollis* (Saussure)]. Male. Dunkeld, Victoria, Australia.

#### Perisphaerini

On the basis of wing venation, this group, which is usually considered to be at least a distinct subfamily, can only be regarded as a tribe of the highly developed Epilamprinae. The group appears to be most closely related to the Oniscosomini and Calolamprini.

The tegmina are distinctive with their strongly angulate plical furrow, a condition not found elsewhere in the Epilamprinae, but which occurs in the Pseudomopinae. The large humeral area which lacks venation in its basal portion is comparable to that of the Oniscosomini

and some other tribes. Posterior subcostal branches are absent as in most of the lower Epilamprinae. The arrangement of the regular anterior radial rami resembles the condition found in the more advanced tribes. A simple, long, apical posterior branch is present as in the Oniscosomini. The separate origin and then fusion for a short distance of cubitus and media, is distinctive.

The wings resemble those of the Oniscosomini in many respects, but  $R_1$  is shorter than in that group. The second plical vein is short and ends in the first plical, much as in the Calolamprini. The third plical vein is stalked on the branched axillary as in many of the tribes, and this latter vein has only one definite branch as in many of the Epilamprini and Litopeltiini.

The tegmina are rather broad and short, almost subrectangulate. The anterior margin is weakly arcuate and rounds into the broadly arcuate apical margin. The posterior margin is weakly concave and the plical notch is not evident. The margin of the anal field has a rounded angulation basally. The humeral area is well developed. The subcosta is heavy and oblique, with a few spaced rami in its apical half. The radius has a number of anterior rami which rarely have secondary divisions. The apical rami are not well developed. A long, simple apical posterior branch is present. The media soon becomes fused with cubitus, then free, and has apparently at least four branches some of which may show secondary subdivisions. The cubitus divides into two main stems each of which have numerous subdivisions. These branches are arcuate or sigmoid and in general go to the postero-apical margin. It is not possible to completely determine the limits of these two systems. The plical furrow is strongly arcuate and delimits a large anal area. Basally the furrow is evenly arcuate, then it has an obtuse angulation; from this to the posterior margin it is arcuate. The subrectangulate anal area has a few simple, relatively straight veins.

The wings have a relatively large preaxillary area and a smaller, moderately developed anal fan. The anterior margin is sigmoid and the apical margin is rounded. A shallow plical notch is evident and the anal field margin is evenly arcuate. The simple subcosta is long, reaching the margin beyond the middle. The radius has a distinct  $R_1$  which basally parallels the subcosta, beyond that it has a few apical

rami. The radial sector is strong and has at least traces of some apical rami. No distinct posterior apical branch is present. The media is a simple vein which is stalked basally on the radial sector. The arculus is transverse. The cubitus is well developed with a number of oblique more or less arcuate sectors, more than half of which go to the apical margin. There is some secondary division of these branches. The first plical vein is strong and straight. The second plical vein is relatively short and ends in the first plical vein. The third plical vein is apparently stalked for a short distance on the branched axillary, then becomes free and goes directly to the margin. No interplical field is present. The branched axillary is simple having only one well-defined branch and behind this there are nine simple anal veins. Throughout the anal field there are short intercalated veins.

Only the typical genus has been examined, but it is believed that a number of other genera can be included in this complex.

Representative figured: *Perisphaerus contiguus* (Burmeister) figs. 33, 100. [Det. Hebard, 1932.] The genotype is *Perisphaerus armadillo* Serville. Male. Mount Lamington, N. E. Papua.

#### Leucophaeini

The Leucophaeini are considered to be the basic tribe of the Epilamprinae and as such have a combination of features that are modified in the more specialized groups. The tegmina, while moderately broad, may be more acute apically than in most of the other tribes. The subcosta has irregular and crowded anterior rami in the apical portion. This limiting of rami is found also in the Panchlorini and rarely in other groups. The radius has its anterior rami more irregular than usual, but still less so than in the Oniscosomini. A definite apical posterior branch is present and the cubital branches are oblique as in most of the tribes. The anal field approximates in length the subcosta.

The wings have a long subcosta as in most of the tribes, but  $R_1$  has fewer anterior rami than in other members of the group except the Calolamprini. The remainder of the radius is relatively simple, but the apical posterior sector is much more distinct than in the other tribes and is secondarily branched. The cubitus has almost one-half of its branches going to the apex, much as in the Paratropini, and more than

in most of the other tribes. The first plical vein is straight apically, not curved forward as in some *Epilamprini*, *Thoracini* and *Paranau-phoetini*. The third plical vein is entirely free from the branched axillary.

The tegmina have a large humeral area. The subcosta has a number of irregular anterior rami, except in the basal third, which show considerable terminal twigging. It is slightly longer than the anal area. The radius has a number of more or less irregular anterior rami, some of which have secondary branches. There are a number of apical rami and a well-differentiated, branched, posterior radial branch. Basally, media is close to radius and apically it has three or more branches, some of which are irregular and may become fused with portions of the radius. The cubitus has a rather large number of sectors which go obliquely toward the postero-apical margin. A number of these show secondary branching. Basally, between this system and the plical furrow, there is a veinless area. The plical furrow is arcuate. The anal field has a considerable number of veins, the more median of which usually have branches.

The wings have the preaxillary area longer, more produced, than the relatively small anal area which is not produced. The plical notch is moderate. The subcosta is long and simple, usually extending almost to the apical third.  $R_1$  parallels the subcosta, beyond this it has three short anterior rami. The remainder of radius is parallel to  $R_1$ , below its rami branching in a regular manner. A distinct, branched, apical posterior branch is present. The media is a simple, somewhat arcuate vein. The cubitus is moderately well developed with oblique sectors some of which show secondary branching. Usually more than one-third, almost half, of these go to the apical margin. Basally, there is some subcubital twigging. The first plical vein is free, distinct and straight. The second plical vein varies from slightly more than one-third to about two-thirds the wing length, and always ends in the first plical. The third plical vein is free, not stalked on the branched axillary, straight to the wing margin, posterior to the plical notch. The interplical area is not expanded. The branched axillary is well developed, having four or five simple branches, and there are twelve or more simple anal veins posterior to it. Intercalated veins are present in the anal field and at times in the preaxillary area.

The following genera that have been examined may be placed in this tribe: *Leucophaea* and *Phortioeca*.

Representatives figured: *Leucophaea maderae* (Fabricius) figs. 37, 102. [Det. J. A. G. Rehn, 1937.] This species is the genotype. Male. Bitje, Ja River, Cameroons.

*Phortioeca phoraspoides* (Walker) figs. 36, 101. [Det. Hebard, 1920.] The genotype is *Zetobora peruana* Saussure [= *Phortioeca peruana* (Saussure)]. Female. San Carlos, Costa Rica.

#### Litopeltini

This tribe is related to the Epilamprini and Panchlorini on the one hand and to the Phoraspidini on the other. The tegmina have the large humeral area lacking, in its basal portion, the venation that occurs in several tribes. The subcostal rami are regular as in the Perisphaerini and Calolamprini, but posterior branches are present as in the Leucophaeini and Epilamprini. The radius is developed much as in the Epilamprini, but the apical posterior branch is not well differentiated, as in the Panchlorini. The branches of media and cubitus attempt to parallel the posterior margin as in the Panchlorini.

The wings have the anal area intermediate in its degree of production. It is larger and longer than in the basic tribes, but not produced as far as the preaxillary lobe, as in the Panchlorini and Epilamprini. In this it is more nearly comparable to the condition found in the Phoraspidini.  $R_1$  is long as in the Epilamprini, but it has only a few incomplete, irregular anterior rami, a condition only approached in some of the other tribes. The radial sector has limited apical rami, and a definite apical posterior branch is not present, thus as in the Panchlorini and Thoracini. The cubitus has approximately one-third of its branches going to the apex, in this agreeing with the more developed tribes. The third plical vein is stalked on the branched axillary as in the Epilamprini, but there are not as many axillary branches as in that tribe.

The tegmina are relatively broad, with the anterior and posterior margins weakly arcuate. The plical notch is indicated. The humeral area is expanded. The subcosta is very heavy and has a short series of regular anterior rami, apically. Branched posterior branches are present. The radius has a relatively few, at times branched, anterior

rami. The apical rami are present and the apical posterior radial branch is not well differentiated. Media rises close to the radius and has three, long, simple branches. The cubitus divides into two main stems, each of which subdivides. These branches and those of media tend to parallel the posterior margin. The area near the plical notch is filled with additional short branches of cubitus. The plical furrow is strongly arcuate. The anal area, which is about equal in length to the subcosta including its posterior branches, has numerous simple arcuate veins.

The wings have a well-developed preaxillary lobe, and the anal lobe is almost equally produced apically. A shallow concave area represents the plical notch. The subcosta is simple and long, reaching the anterior margin beyond the middle.  $R_1$  reaches the margin at about the apical fourth and has a few irregular anterior rami. The radial sector parallels  $R_1$  and has branched, incomplete, apical rami. A definite apical posterior radial branch is not present. The media apparently rises from the middle of the arculus and is a simple, sigmoid vein. The cubitus has a series of oblique, arcuate branches, the more basal of which are irregular. About one-third of these branches go to the apical margin. The first plical vein is simple and straight. The second plical vein is relatively long and its end is free. The third plical vein is stalked basally on the branched axillary and is straight. A small interplical area is present. The branched axillary has only one definite branch and behind it there are at least ten simple anal veins. Intercalated veins are found throughout the wing and some may be present in the tegmina.

It would appear that the genus *Derocalymma* may also belong to this tribe. The tegmina in this genus, for the most part, are very dense and such venation as is evident can not be fully interpreted. The wing, on the other hand, resembles that of *Litopeltis* in most respects, differing only in the shorter subcosta, fewer branches of cubitus, and short second plical vein. Not as many of the cubital branches proportionately go to the apical margin and the second plical vein ends in the first plical vein.

Representatives figured: *Derocalymma versicolor* (Burmeister) figs. 35, 104. [Det. J. A. G. Rehn, 1932.] This species is the genotype. Male. Kuke Pan, South Africa.

*Litopeltis bispinosa* (Saussure) figs. 34, 103. [Det. J. A. G. Rehn, 1927.] This species is the genotype. Male, female. Panama City, Panama.

#### Epilamprini

This distinctive tribe is one of the more highly developed members of the subfamily. The tegmina are relatively broad and have an expanded humeral area that is usually practically filled with the subcostal rami. These are more regular and stronger than in the other tribes except the Nauphoetini, which has a narrower humeral area. The radius has long, anterior rami, more spaced than in the Leucophaeini and less so than in the Nauphoetini and Panchlorini. The apical rami are longer and more regular than in related tribes. The media and cubitus have their branches tending to parallel the posterior margin much as in the Panchlorini and some other tribes, but the branches are more numerous. The anal area is more elongate than in most tribes, resembling the Thoracini, and not as extreme as in the Paranauphoetini.

The wings have the anal area produced, equal to the preaxillary area as in the Nauphoetini and Panchlorini, but the plical notch is more evident than in those groups. The subcosta is longer than in most tribes except the Leucophaeini and  $R_1$  has only a few rami as in that group. The radial sector has its apical rami more regular than in most tribes, and a short apical posterior radial branch is differentiated as in the Nauphoetini. The cubitus has less than a third of its branches going to the apical margin as in the Nauphoetini and Panchlorini. The first plical vein is curved forward apically as in the Nauphoetini, Paranauphoetini and Thoracini. The third plical vein is stalked basally on the branched axillary, and after becoming free is close to it. This plical vein curves down apically as in the Paranauphoetini and Phoraspidini and a small interplical field is present. There are a larger number, twelve or more, of simple anal veins than in the less-developed tribes.

The tegmina are rather broad and the humeral area is well developed. The subcosta is always heavy basally and has rather regular, usually heavy, anterior rami, and a simple, thickened posterior branch may be present. The radius has rather regularly spaced, long, anterior



rami which normally have a few secondary divisions. The apical rami may have subdivisions, and the apical posterior radial branch, when present, is simple, either short or long. Media basally is close to radius, and has from one to four branches which may subdivide. In *Epilampra* this vein is simple. The cubitus has rather regular branches which usually are from the stem that parallels the plical furrow. These branches, which may subdivide, vary from oblique to attempting to parallel the posterior margin. The plical furrow is strongly and evenly arcuate. The anal field has a rather large number of veins, the more median ones rarely branched.

The wings have the anal lobe produced, equal to the preaxillary lobe. The subcosta is simple and long, reaching the margin beyond the middle.  $R_1$  has three or four simple terminal branches. The radial sector has rather regular, but as times secondarily branched apical rami. The apical posterior radial branch is always simple and may be very short. The media apparently rises from the top of the arculus and is simple, usually arcuate. The cubitus has a considerable number of oblique branches normally very regular and evenly spaced, rarely somewhat irregular without basal twigging. All but three or four of the main branches go to the plical fold. The first plical vein apically curves forward. The second plical vein varies from one-third to two-thirds the wing length and usually ends in the first plical vein. The third plical vein is stalked basally on the branched axillary, then parallels it. Apically it curves down and a small interplical field is present. The branched axillary has three or four simple branches and behind this there are at least a dozen simple anal veins. The anal field always has intercalated veins and the preaxillary portion usually does except in the genus *Epilampra*.

In addition to the forms studied, it is believed that a considerable number of genera belong to this tribe.

Representatives figured: *Epilampra abdomen-nigrum* (De Geer) figs. 39, 105. [Det. Hebard.] The genotype is *Epilampra nebulosa* Burmeister. Male. Caparo, Trinidad.

*Homalopteryx laminata* Brunner figs. 38, 106. [Det. Hebard, 1920.] The genotype is *Homalopteryx capucina* Brunner. Male. Caparo, Trinidad.

*Morphna plana* (Burmeister) figs. 40, 109. [Det. Hebard, 1935.] The genotype is *Epilampra maculata* Brunner [= *Morphna maculata* (Brunner)]. Male. Mousakanda, Gammaduwa, Ceylon.

#### Nauphoetini

This tribe is most closely related to the Panchlorini, but the tegmina and wings are not as specialized as in that group. The tegmina in shape are intermediate between those in the Panchlorini and the Epilamprini. The humeral area is not expanded as in the Panchlorini, but is filled with numerous subcostal rami. The radius is much as in that tribe, but usually has the apical posterior branch well defined. The branches of media and cubitus are more oblique, going toward the postero-apical angle. The subcosta is shorter than the anal area as in some of the less specialized tribes.

The wings have the anal lobe produced, equal to the preaxillary one as in the Epilamprini. The subcosta is as in the Panchlorini and Thoracini, while the radius is more as in the Epilamprini with a definite apical posterior radial branch. The cubitus has about one-third of its branches going to the apex as in both the Epilamprini and Panchlorini. The first plical vein may be straight or upcurved apically, the former as in the Panchlorini and the latter as in the Epilamprini. The third plical vein is free from the branched axillary and is straight as in the Panchlorini. However, the branched axillary has at least two definite branches as in many of the more generalized tribes.

The tegmina have the anterior and posterior margins subparallel and the apical margin is broadly rounded as in the Panchlorini. The plical notch is not evident. The humeral area is not expanded and it is filled with the irregular anterior branches of the subcosta. The subcosta, which may have posterior branches, is shorter than the anal area. The radius has a series of spaced anterior rami which may branch secondarily. Branched apical rami are present and an apical posterior radial branch is at least indicated. The media has either two or three branches and may have terminal twigging. The cubitus has a number of regular, oblique branches, which may subdivide, that go toward the postero-apical angle. The plical furrow is evenly arcuate. The elongate anal area has a number of veins, some of which may branch.

The wings have the preaxillary area relatively large and the anal lobe is as produced as that area. The plical notch is indicated by a shallow concavity. The subcosta is simple and reaches the margin near the middle.  $R_1$  is distinct and has regular spaced anterior rami. The radial sector has a few apical rami, and a relatively short, simple apical posterior radial branch is present. The media is either stalked on the radial sector or apparently rises from the top of the arculus. It is a sigmoid vein that may have terminal twigging. The cubitus has at least twelve regular, simple branches, of which not more than one-third go to the apical margin. The first plical vein is either straight or curved forward apically. The second plical vein varies from about one-third to two-thirds the wing length and ends in the first plical. The third plical vein is free from the branched axillary and is straight to the margin. A small interplical field is present, larger in those forms that have the first plical curved forward. The branched axillary has at least one definite branch, but it is not possible to tell if there are more divisions. In all, at least thirteen veins reach the margin in the anal area. Intercalated veins are present in the anal lobe and may be found in the preaxillary one. At times, they are found in the tegmina.

It is believed that in addition to the forms studied, a considerable number of genera may be referred to this tribe.

Representatives figured: *Leurolestes pallidus* (Burmeister) figs. 41, 111. [Det. Hebard, 1919.] This species is the genotype. Male. Key West, Florida.

*Nauphoeta cinerea* (Olivier) figs. 47, 110. [Det. Hebard, 1928.] This species is the genotype. Female. Fort de Kock, Sumatra.

#### Panchlorini

This tribe is most closely related to the Nauphoetini. The tegmina are more slender than in most of the tribes. The spaced branches of cubitus that attempt to parallel the posterior margin are characteristic. The humeral area is not expanded and has only the terminal subcostal rami, as in the Calolamprini and Litopeltini. The anterior and apical rami are much as in the Epilamprini, but are more spaced as in the Nauphoetini.

The wings have a full anal lobe, but it is not as produced as the preaxillary one, thus being intermediate between the condition found in

the Leucophaeini and that in the Epilamprini. The subcosta is short as in the basic tribes, but  $R_1$  has a large series of regular rami, either more or more regular rami than in any other tribe. An apical posterior radial branch is absent. The cubitus does not have more than one-third of its branches going to the apex, as in the Epilamprini and Nauphoetini. The first plical vein is straight, and the third plical vein is straight and free from the branched axillary as in the Nauphoetini. It is not possible to determine the number of branches of the axillary, a condition practically distinctive as it occurs elsewhere only in the highly modified Thoracini and Paranauphoetini.

The tegmina are relatively slender with the anterior and posterior margins subparallel. The apex is broadly rounded and the plical notch is at least indicated. The humeral area is not expanded. The subcosta usually has some regular anterior rami apically and it may have a series of posterior branches (*Panchlora*). The radius has spaced anterior rami, some showing secondary branching. The apical rami have regular subdivisions. The apical branch is simple or not differentiated. The media has its base close to radius and has either two or three simple branches. The cubitus which is very regular has branches that rise from the stem that parallels the plical furrow, and these are more or less parallel to the posterior margin. The plical furrow is evenly arcuate. The anal area has numerous veins, some of which may have branches.

The wings have a relatively large preaxillary area and a definite plical notch. The subcosta is simple and reaches the anterior margin near the middle.  $R_1$  is well developed, with a regular series of anterior rami, connected apically in *Panchlora*. The radial sector has a few apical rami, and a definite apical posterior branch is not present. Media usually rises from the top of the arculus and is a simple, arcuate vein. The cubitus has a number, usually twelve, of regular oblique branches of which about one-third go to the apical margin. The first plical vein is simple and direct. The second plical vein is short, at times ending in the first plical. The third plical vein is distinct from the branched axillary and is straight to the margin behind the plical notch. The axillary is strong, but it is not possible to determine if it has branches. There are at least twelve simple veins that go to the margin of the anal field. Intercalated veins are present in the anal field and may be present in the preaxillary area.

It seems probable that many genera in addition to those studied belong to this tribe.

Representatives figured: *Panchlora cubensis* Saussure figs. 48, 108. [Det. Hebard, 1919.] The genotype is *Panchlora pulchella* Burmeister = *Blatta quadripunctata* Stoll [= *Panchlora quadripunctata* (Stoll)]. Male. Villavicencio, Colombia.

*Pycnoscelus surinamensis* (Linnaeus) figs. 42, 107. [Det. Hebard, 1928.] The genotype is *Pycnoscelus obscurus* Scudder = *Blatta surinamensis* Linnaeus [= *Pycnoscelus surinamensis* (Linnaeus)]. Female. Fort de Kock, Sumatra.

#### Thoracini

The members of this tribe are highly specialized Epilamprinae. One feature that will separate this complex from all other Blattaria is the large forward-curving anal field of the wing.

The tegmina resemble in some respects those of several of the other tribes. *Thorax* has a produced humeral area, and the radius much as in the Epilamprini, while *Oxyhaloa* agrees in most respects with the Paranauphoetini and in others with the Panchlorini. Features such as the short subcosta and elongate, subangulate anal field are also shared with some Pseudomopinae. There does not appear to be a combination of tegminal features that would allow recognition of this tribe.

The wings show a close relationship with the Paranauphoetini and agree in many respects with those of other tribes. The apically narrowed preaxillary lobe and the produced, forward-curving anal field are distinctive. The long  $R_1$  with numerous short rami and the lack of a definite apical posterior radial branch are features shared with the Paranauphoetini and Panchlorini. The cubitus has at least some of its basal branches fusing with the first plical vein as in the Paranauphoetini. The curving forward of the first plical vein and its fusing apically with portions of the cubital branches is distinctive. The third plical vein does not become free from the branched axillary until after its last branch, as in the Paranauphoetini. The forward curving of this vein combination is distinctive. There is a small interplical field as in the Paranauphoetini.

The tegmina are moderately elongate and vary from rather slender to relatively broad. The anterior margin is weakly arcuate, the apical

margin roundly angulate and the posterior margin is arcuate to the plical notch. This notch is not well developed. The humeral area may or may not be enlarged. The subcosta is heavy and direct, either simple or with apparently a few slender anterior rami. The radius has a number of regular anterior rami and apical rami are present. An apical posterior branch is always well developed and shows at least some secondary divisions, these going to the extreme apex. The media basally is close to the radius, then diverges and has at least two well-developed branches. Basally, between it and cubitus is an area which is free from venation. The cubitus rises near and for a distance parallels the plical furrow. This vein has six or more major branches that go obliquely toward the postero-apical margin. The plical furrow is strong, evenly arcuate in *Thorax* and subangulate apically in *Oxyhaloa*. The anal area has a number of veins; those in the middle of the field are oblique and show some branching. In general, those in the anterior portion are arcuate, and more or less parallel the plical furrow, while those in the posterior portion are arcuate and attempt to parallel the posterior margin.

The wings have a small preaxillary area which is distinctly constricted apically because of the anterior prolongation of the anal field. The anal field is very large, prolonged anteriorly and produced with a full fan. The anterior margin of the wing is weakly arcuate. The very small apical margin is evenly rounded. A shallow but distinct plical notch is present, followed by the evenly arcuate margin of the anal fan. The subcosta is strong and parallels the anterior margin. In *Thorax*, it is simple and ends slightly beyond the middle, while in *Oxyhaloa* its tip is bifurcate and it ends at about the middle of the wing. The radius has  $R_1$  distinct and more or less parallel to the subcosta. Past this vein it has numerous anterior rami, regular or irregular; and it ends at approximately the apical fifth. The radial sector is strong with a few apical rami, and more or less parallels  $R_1$ . No definite apical posterior branch is preserved. The media apparently rises either from the top or the middle of the arculus and is sigmoid. The cubitus is well developed and has a number of oblique sectors which go to the plical fold. Rarely, these show some secondary division. In *Oxyhaloa*, all these sectors fuse terminally with the first plical vein, from which they are indistinguishable, while in *Thorax* only the apical

ones are fused with the first plical. The first plical vein is prominent, strongly curved forward apically. The second plical vein varies from about one-fifth to one-half the wing length and always terminates in the first plical. The third plical vein is fused for most of its length with the branched axillary. Apically, the last anterior branch from the axillary is considered to represent this vein. A small but distinct interplical field is evident. There are apparently eight branches to the well-developed branched axillary and these support approximately one-half of the anal field. Behind this, there are at least eight simple anal veins.

To this tribe belong the genera *Thorax* and *Oxyhaloa*. Also the peculiar genus *Phlebonotus* would appear to be a member of this complex. *Notolampra* is a member of this assemblage but may be distinguished by its much larger plical field. In this form, the third plical vein curves posteriorly instead of paralleling the first.

Representatives figured: *Oxyhaloa buprestoides* (Saussure) figs. 43, 115. [Det. J. A. G. Rehn, 1922.] This species is the genotype. Male. Baracoa, Cuba.

*Thorax porcellana* Saussure figs. 49, 114. [Det. Hebard, 1935.] This species is the genotype. Male. Battaramulla, Wp., Ceylon.

#### Paranauphoetini

This distinctive tribe is most nearly related to the Thoracini, but differs from it in many respects. The tegmina are proportionately more elongate than in any of the other tribes and their sigmoid anterior margin is also distinctive. The plical furrow is arcuate and marks off an elongate anal field, equal to about one-half the tegminal length, longer than in any other tribe, as in the Panesthiidae. The simple sigmoid subcosta is like that of *Oxyhaloa* except it is heavier, and the well-developed branched apical posterior radial branch is as in that genus. The regular anterior and apical radial rami are as in the Thoracini and some Epilamprini. The three branched media and numerous oblique cubital branches are as in many of the Epilamprinae.

The wings have a relatively small preaxillary area and a full anal area as produced as the preaxillary. A small interplical field is present and the plical notch is absent. It agrees in the first feature with the

more highly developed tribes. The subcosta, radius and media are essentially as in the Thoracini. The cubitus has its basal branches fusing with the first plical vein as in that group, but its apical branches fuse terminally and form an accessory vein parallel to the first plical. Thus none of the branches go directly to the apex. This condition is distinctive, but resembles that found in the Thoracini. The third plical vein is stalked on the branched axillary as in that group, but does not curve forward apically.

The tegmina are more dense basally than in the other tribes. The anterior margin is weakly sigmoid, and the apical margin is strongly rounded. The subcosta is simple, sinuate, very heavy and equal to about one-half the length of the anal field. The radius which is very heavy basally, has a series of spaced, regular anterior rami before the origin of the radial sector. Beyond this  $R_1$  has additional spaced anterior and apical rami. The apical posterior radial branch, which rises at approximately the apical third, has some secondary divisions. The media is strong and before the mid-point divides into two stems, one of these later subdividing just below the origin of the radial sector; no evidence of terminal twigging is present. The cubitus is strong and has five or more branches, which go diagonally towards the postero-apical angle. A few indirect basal branches are also present. The plical furrow is arcuate, and reaches the posterior margin near the middle. The exceedingly long, lanceolate anal field has traces of a few simple veins.

The wing is subtruncate apically and lacks a distinct plical notch. The subcosta is simple and extends to about the middle of the wing.  $R_1$  has a number of rather irregular anterior rami. The radial sector and media are stalked basally; past this point the radial sector parallels  $R_1$ , terminally it has two simple branches. The apical posterior branch is not well differentiated. Media after becoming free is simple and direct. The cubitus has its basal sectors passing to the plical furrow, all but the apical three join the first plical vein. These three are joined terminally to form an accessory vein which goes to the wing apex. The first plical vein is strong and upcurved apically. The second plical vein is relatively short, ending in the first plical. The third plical vein is stalked on the branched axillary, rising after the last axillary branch, and is down-curved apically. The curving first and third



plical veins bound a small interplical field, which is comparable to that of other Epilamprinae and in a way to the intercalated triangle found in certain of the Pseudomopinae. No trace of folding in this area is noted. The anal area has thirteen simple anal veins counting the members of the branched axillary; how many of these are branches of this vein cannot be determined. The entire anal field has intercalated veins, but these are absent in the preaxillary region.

Only the nominate genus, *Paranauphoeta* is placed in this tribe.

Representative figured: *Paranauphoeta lyrata* (Burmeister) figs. 45, 112. [Det. Hebard, 1922.] The genotype is *Blatta circumdata* Haan [= *Paranauphoeta circumdata* (Haan)]. Male. Kuching, N. W. Borneo.

#### Phoraspidini

This tribe, although very distinct, appears to be most closely related to the Epilamprini, Thoracini and Paranauphoetini. The almost subtrigonal tegmina and the slender subcosta with simple, regular rami apically are distinctive. Irregular radial rami and a simple apical posterior branch show some resemblance to the condition found in the Epilamprini. The oblique cubital branches represent the primitive condition in the complex.

The wings have a short branched subcosta and lack a definite  $R_1$ , both distinctive characteristics. The radial rami are more developed than in other tribes. The cubitus, with less than a third of its branches going to the apical margin, is a feature shared with the Epilamprini. The third plical vein has its apex curving posteriorly as in some Epilamprini, and Paranauphoetini and the Paratropini.

The tegmina are practically subtrigonal in outline, with a greatly expanded humeral area and a narrowly rounded apex. The subcosta is slender and has four simple anterior rami in its apical half. The radius has a series of irregular, and secondarily branched anterior and apical rami. A simple, apical posterior branch is present. Media divides into two long branches, one of which subdivides apically. The cubitus has four simple, oblique branches which go to the posterior margin. It is less developed than in any of the other tribes. The plical furrow is subangulate apically, much as in some Pseudomopinae. No plical notch is present. Traces of a few simple arcuate anal veins are evident.

The wing has the anal field slightly produced, much as in the Calolamprini, Epilamprini and Panchlorini. The subcosta is short as in the Calolamprini, but it is forked terminally, a condition that is distinctive.  $R_1$  is not differentiated. The radius has spaced anterior rami, which rarely subdivide. A few apical rami and a short simple apical posterior branch are present. The media is simple, weakly sigmoid. The cubitus has over a dozen oblique sectors of which about one-third go to the apex. The first plical vein is simple, slightly up-curved apically. The second plical vein is long and free apically. The third plical vein is stalked basally on the branched axillary, apically it curves posteriorly. A small interplical field is present. There appear to be three or four simple branches to the axillary. Thirteen veins reach the margin in the anal area. Intercalated veins are found throughout the wings.

Only the typical genus is included in this tribe.

Representative figured: *Phoraspis picta* (Drury) figs. 50, 113. [Det. Hebard, 1922.] This species has been indicated as the genotype. Male. Brazil.

#### Paratropini

This tribe does not appear to be closely related to any of the others, but it may best be compared with the Leucophaeini. The tegminal shape is as in that group, as is the development of the subcosta, which is as long as the anal field. Also, definite posterior subcostal branches are present as in that and some other tribes. The large number of irregular, and secondarily branched anterior radial rami are distinctive, although easily derived from the condition found in other tribes. It is not possible to differentiate fully between radius, media and cubitus as they appear to have a common origin. Whether an apical posterior radial branch is present or not can not be determined. The media is certainly branched, but the number of branches can not be ascertained. This vein and cubitus both have their branches practically parallel to the posterior margin as in the Panchlorini.

The wings are much like those of the Leucophaeini, but the pre-axillary area has its apex more angulate.  $R_1$  is only forked terminally and is shorter than in the other tribes. The branched axillary has its branches more terminal than in other tribes.

The tegmina are broad with the apex rounded. A large humeral area is present and it is filled with the anterior subcostal rami. This vein is very heavy, with apical heavy rami, and at least two posterior branches. There are numerous irregular anterior radial rami, many of which branch secondarily. The branches of media and cubitus are numerous and parallel the posterior margin, and some of them subdivide. The plical furrow is evenly arcuate and there is no plical notch. Only a few irregular veins can be found in the anal field, less than in other tribes.

The wings have a relatively large preaxillary area, and a smaller, not produced anal field. The subcosta is simple and goes to the anterior margin at about the middle.  $R_1$  reaches the margin immediately after the subcosta and has only a terminal fork. The radius has a number of secondarily branched anterior and apical rami. A very short, simple apical posterior branch is present. The media is weakly sigmoid and forks near the apex. The cubitus has more than a dozen oblique branches of which one-half go to the apex. The first plical vein is straight and simple. The second plical vein is long and its apex is free. The third plical vein is remote from the branched axillary and its apex curves posteriorly. The branched axillary has three branches which originate near the apical third. Behind this are thirteen simple anal veins.

Only the typical genus is placed in this tribe.

Representative figured: *Paratropes phalerata* (Serville) figs. 44, 120. [Det. Hebard, 1920.] The genotype is *Paratropes lycoides* Serville. Male. Muzo, Boyacá, Colombia.

#### BRACHYCOLINAE

The unusual genera placed in this subfamily appear to be unique in many respects. Their venation is for the most part more irregular than is normal in the Blattaria. Moreover, the shape of the wing is such, through reduction, that it appears these insects are not capable of flight. The strikingly marked irregularly veined tegmina and the wings with their proportionately small anal area, incapable of being flattened, and amorphous venation will differentiate the Brachycolinae from other groups.

In the tegmina, the subcosta may have some anterior rami as in primitive Blattidae. The radius has a distinct  $R_1$  and a well-developed apical posterior branch. In *Hormetica*, there are a large number of branches. In these features, they resemble the Blattinae and to some extent the Blaberinae, particularly in the tendency for anterior crowding. The media is well developed with a number of branches, thus resembling the Nyctiborinae, except that they do not fill the apical margin. Cubitus has numerous oblique branches, resembling the more primitive blattids. The strongly arcuate plical furrow shows a resemblance to the condition found in the Epilamprinae.

The wings resemble, at least in the radial area, the condition found in the Blattinae. The retention of a branched media could show relationship to this or other primitive groups. Cubitus with its freely branching sectors mostly going to the apex, resembles the condition found in some Epilamprinae and the Blaberinae. An archidictyon at the base of cubitus is also found in the Blattinae and Blaberinae. The first plical being involved apically with the terminal coalescing of the cubital branches, as well as the third plical being stalked, in *Brachycola*, for a long distance on the branched axillary, are conditions found also in the Epilamprinae, particularly the Thoracini.

The tegmina are relatively short and broad, and have a network of small irregular cells, so that the actual venation is partially obscured. The humeral area is well developed and the anterior margin is weakly sinuate or rounded. The apical margin is rounded and the posterior margin is arcuate. A definite plical notch is evident. The subcosta may have a number of irregular anterior rami. Basally this vein is heavy and sinuate, while ventrally it is produced to form a tegminal catch. The radial system presents either a relatively simple branched design or a mass of amorphous branches.  $R_1$  is either simple or with anterior rami. The sector has irregular anterior branches, many showing secondary branching and with some indication of terminal twigging. The media is strong, but hard to differentiate from the other systems, with at least three major branches. Some secondary division is present. The cubital area has a stem which divides into three major branches, each of which has a number of secondary branches. These are either straight, oblique or arcuate. The plical furrow is strong, evenly arcuate, terminating at a well-developed notch. The anal area

has an indeterminate number of simple anal veins. In general, they are more or less parallel to the posterior margin.

The wings of this subfamily show considerable diversity, and due to their extreme individual irregularity and inconsistency only general tendencies are noted. The relatively large preaxillary portion is in contrast to the small anal fan. The presence of a definite plical notch is in common with most of the primitive types. The anterior margin is nearly straight, roundly passing into the apical margin. The margin of the anal field is broadly and evenly arcuate. The subcosta is either simple or apparently fused with  $R_1$ , which has a variable number of rami. The radial system has an indeterminate number of irregular branches, many of these secondarily dividing and all with some evidence of terminal twigging. An apical posterior branch appears to be present. The arculus is definite in *Brachycola* and probably is represented in *Hormetica* although it is not well differentiated. Media is a strong, but irregularly branched vein. At times, some of its branches become fused or at least connected with some of the cubital sectors. Practically all its branches subdivide and some show apical twigging. Cubitus has a variable number of sectors, usually somewhat more than half of which go to the plical area and the remainder to the wing apex, many having secondary branching. The first plical vein is well developed although it does not always extend to the apex. At times it apparently has accessory branches apically and becomes involved with the fused terminal portion of the apical cubital sectors. The second plical vein is either relatively short and ending free, or represented by a series of sections showing no definite connections. The third plical vein is either stalked on the branched axillary or it is free practically to its base. In all cases it reaches the wing margin behind the plical notch. The branched axillary has three or four branches, followed by a series of from eight to fourteen simple (or practically so) anal veins. The branched axillary is not set off from the other veins. The entire anal field usually has intercalated veins, and at times the apical portion of the preaxillary area also has these veins.

The exact relationships of these forms will probably have to be ascertained by features other than wing venation. In looking at the tegmina and wing one is impressed by their irregularity and pseudo-primitiveness, reminding the observer of the atavistic condition which is sometimes noted in other Orthoptera.

Representatives figured: *Brachycola tuberculata* (Dalman) figs. 46, 119. [Det. Hebard, 1921.] This is the genotype. Female. Organ Mountains, Brazil.

*Hormetica apolinari* Hebard figs. 51, 116. [Det. Hebard, 1920.] The genotype is *Hormetica laevigata* Burmeister. Female. Villaviciencio, Colombia.

#### BLABERINAE

These large distinctive blattids seem to retain a number of primitive characteristics. In general, their venation is simple although it has become increased by the secondary division of many of the veins. The large humeral area agrees with that found in some of the Epilamprinae as does the simply and regularly branched media. The regular, oblique branches of cubitus indicate an affinity to this same subfamily. The tendency for the apparent anterior crowding of radius is characteristic.

The anterior crowding of the radius in the wings is distinctive. The single, branched media is a condition intermediate between the primitive and specialized Blattidae. The regular, oblique, branches of cubitus, about one-half of which go to the plical furrow, is a condition also found in the Epilamprinae. The third plical vein, which is distinct from the branched axillary, is comparable to that found in the Blattinae and pseudomopoids. The long, simple subcosta and the branched axillary with only a few branches, and not well differentiated from the remaining anal veins, again are features that agree with the Epilamprinae. This subfamily appears to occupy a position between the primitive Blattinae and the more highly specialized Epilamprinae.

The tegmina vary from relatively short and broad to rather long and relatively slender. At least in the genus *Archimandrita*, the former condition is characteristic of the female. The anterior margin is evenly arcuate and the plical notch is scarcely indicated. The margin of the anal field is rounded angulate basally, the remainder being practically straight. A well-developed humeral area is present. The subcosta is strong and extends more or less obliquely to about the middle of the anterior margin. It may have regular anterior rami throughout its length, or these may be crowded, irregular and only present in the apical half. A forked or divided posterior branch is present. The radius is well developed, but gives the impression of

being crowded anteriorly. It has a number of rather irregular anterior rami many of which show secondary branching. There are some apical rami with numerous subdivisions. A distinct apical posterior branch is present, and it usually has some secondary divisions, these normally terminating at or near the extreme apex. The media is well developed having four or five major branches which may have secondary divisions, all terminating at the apical margin. The cubitus normally divides into two major stems, each of which divides into at least three, normally four or more branches which in turn may subdivide. These branches in general go obliquely towards the posterior margin with the exception of the basal one, which tends to parallel the plical furrow and by subdivision completely fills the area between this furrow and the more oblique sectors. The plical furrow is strong and usually evenly arcuate. The anal field ranges from considerably shorter than, to almost as long as, the subcosta, and it has a considerable number of simple arcuate veins. These in general tend to parallel the plical furrow and a few of the most posterior veins show some terminal branching. The tegmina have at least indications of intercalated veins throughout most of their area.

The wings have a relatively large preaxillary area and a moderate to well-developed anal fan. The preaxillary area is considerably broader in the genus *Archimandrita* than in *Blaberus*. The anterior wing margin is nearly straight and the apical margin is either evenly and broadly arcuate (*Archimandrita*), or rounded obtuse-angulate (*Blaberus*). The plical notch is relatively shallow and the margin of the anal field is evenly and broadly arcuate. The subcosta is simple and parallels the anterior margin, passing at least the midpoint of the wing, and in *Archimandrita* extending almost to the apical margin.  $R_1$  usually becomes free from the remainder of radius near the base and parallels the subcosta for a considerable distance, and may have either a terminal fork or a few rami which pass anteriorly to the subcosta (*Archimandrita*). The radial sector basally more or less parallels  $R_1$  and at about the midpoint some apical rami develop. These often show secondary and further divisions. The apical posterior branch of the radius is always distinct and has either terminal twigging or secondary branching. The media apparently rises from the top or the middle of the arculus and is arcuate, normally with a division into

two branches which may have apical twigging. The arcus is prominent and either transverse or somewhat oblique. The cubitus is well developed and has numerous branches, these varying from fifteen to approximately twenty with about one-half going to the apical margin and the other half to the plical furrow. Some of them have secondary division, but terminal twigging is not evident. The more apical ones are inclined to be arcuate while the more basal ones are oblique. The first plical vein is strong and direct. The second plical vein may be simple and complete or simple and equal to about one-half the wing length, with its apex free. The third plical vein is free basally, but close to the branched axillary and goes directly to the apical margin, rarely showing terminal twigging. A small interplical field may be present. Basally the area on either side of the second plical shows some irregular short accessory veins. It is believed that these have been developed to strengthen the exceedingly large wing. The branched axillary is prominent and has at least three major branches, rarely showing some secondary division. Behind this there are at least twelve simple anal veins, and some other short veins which do not have connections with the basal bar, but may be stalked on an anal vein. The entire anal field has strong, well-marked intercalated veins. In the genus *Archimandrita* intercalated veins are present throughout the wing except in the subcostal area, while in *Blaberus* these are not as strongly indicated.

To this subfamily belong the genera *Blaberus* and *Archimandrita*.

Representatives figured: *Archimandrita tessellata* Rehn figs. 52, 117. [Det. Hebard, 1917.] The genotype is *Blatta marmorata* Stoll [= *Archimandrita marmorata* (Stoll)]. Male. Colon, Panama.

*Blaberus giganteus* (Linnaeus) figs. 53, 118. [Det. Hebard, 1917.] This species is the genotype. Male. Muzo, Boyacá, Colombia.

#### PSEUDOMOPOID COMPLEX

The pseudomopoid complex includes the four related subfamilies (Pseudomopinae, Anaplectinae, Ectobiinae and Ceuthobiinae). All of these have the tegmina with rather simple venation. The subcosta, while primitively with a few rami, or forked, is usually simple, while in other groups it often has numerous rami. Posterior branches of



the subcosta are usually not present, while in the other groups, with the exception of the Blattinae, they are common. The radius has more regular and more nearly vertical anterior rami than in the other groups. The apical posterior branch is variable. Media, while primitively four branched as in the Blattinae and epilamproids, may be fused with cubitus, a condition only rarely occurring in other groups. The cubitus when not fused with media has its branches oblique, or tending to parallel the posterior margin as in the Nyctiborinae, except when it is reduced to a simple stem. When fused with the media the sectors are more oblique than in the other groups, passing toward the posterior margin. The anal veins go diagonally across the field, not all uniformly curving as in the Blaberinae, or showing branching as in the other epilamproids and Blattinae.

The wings have the subcosta shorter than in other groups and it is simple. Usually  $R_1$  is distinct and it may be simple or with some rami much as in the Blattinae, but it is not as long as in other groups, or as branched as in the epilamproid complex. The anterior branches of radius are more regular than in the other groups, but could easily have been derived from the Blattinae type. Media is normally simple as in most of the epilamproids. The cubitus usually has all its branches going to the apex. There are rarely more than six branches, often more reduced; this condition which is diagnostic of the group has clearly evolved from that found in the Blattinae. An appendiculate field, supported only by the third plical vein or an intercalated triangle, is developed by some components and this is also distinctive. The third plical has its base remote from the branched axillary, as in the Blattinae and certain of the epilamproid complex. The axillary has not more than five branches and does not support a large portion of the anal field.

#### PSEUDOMOPINAE

The Pseudomopinae, while the dominant member of this complex, are an assemblage of very diverse forms, but their tegmina have a distinctive combination of features. In most of the forms the subcosta is simple as in the Ectobiinae, but a few of the primitive forms have some rami as in the Anaplectinae and Ceuthobiinae. The radius has spaced, regular rami and usually some branched apical rami, while in the three

related subfamilies the apical rami are usually not differentiated. In some tribes a distinct posterior apical branch is present, as in the Ectobiinae, but it ends at the apex of the tegmina, while in the Ectobiinae it goes posteriorly. Other tribes lack this branch and resemble the Ceuthobiinae and Anaplectinae. The media may be branched or it may be reduced to a single vein as in the Ceuthobiinae. At times it is fused with cubitus as in the Anaplectinae and Ectobiinae. The cubitus, when it is free from the media, has its branches oblique, to more or less parallel to the posterior margin, as in the Ceuthobiinae. When it is fused with media the branches go obliquely, or arcuately, towards the posterior margin as in the Ectobiinae. The plical furrow may be angulate apically, but in some forms it is evenly arcuate as in the other subfamilies. The moderate number of anal veins are, more than in the other subfamilies of the complex, in general arcuate.

The wings do not have an appendiculate field as in the Ectobiinae and Anaplectinae, but, at times, have an intercalated triangle, supported by the third plical vein. The small interplical field, which is sometimes present, is reminiscent of the condition found in certain of the Epilamprinae. The margin of the branched axillary area is not greatly produced as in the Ceuthobiinae. The radius often has a definite apical posterior branch as in the Anaplectinae, but, at times, is undifferentiated as in the Ectobiinae and Ceuthobiinae. The cubitus usually has six or fewer branches which go to the apex. It is not reduced to a simple vein, except where the entire wing is reduced, as in the other subfamilies. The main vein stems do not coalesce apically as in the Ectobiinae. The first plical vein is either straight or upcurved, apically, but does not fuse with the cubitus as in the Ectobiinae, but may fuse with one of its branches, or is not lost as in the Anaplectinae. The second plical vein is often relatively long, as in related subfamilies, either free or fused apically with the first plical. The third plical vein is either straight or down-curved apically, not supporting an appendiculate field as in the Anaplectinae and Ectobiinae. When an intercalated triangle is developed, the third plical is straight and serves as its support. If an interplical field is present, this plical vein curves downward and bounds the area posteriorly. The branched axillary is remote from the plical veins and is distinct from the other anal veins, as in the other members of the group. This vein usually has four or

five branches, not reduced to two or three branches as in most related subfamilies. Anal cross veins are usually numerous, not reduced to one or two series as in the related subfamilies.

The tegmina are usually relatively long and slender, but are broader and shorter in the Baltini, Euandroblattini and in those forms showing reduction. The anterior margin which is usually weakly arcuate may at times be almost straight or subsigmoid. Those forms with long tegmina have the apex rounded, at times narrowly so, while the forms with shorter tegmina may have the apex either broadly rounded or subtruncate. The posterior margin is either almost straight or weakly arcuate. The plical notch is always indicated, but is never very strong. The margin of the anal field is either arcuate or subangulate basally. The subcosta is heavy, usually weakly sinuate and reaches the margin near the basal third, rarely near the middle (Baltini). In the most primitive tribes a few simple anterior rami, and rarely posterior rami (*Parcoblatta*), are present, but usually this vein is simple. A distinct  $R_1$  is not developed, but there is a regular series of spaced anterior rami, rarely thickened (Baltini). Simple, branched apical rami are usually present and a distinct apical posterior branch may or may not be developed. The media, when it is free from the cubitus has usually three, but may have from two to five, major branches; terminal twigging is present only in the Parcoblattini. The cubitus, when free from the media, often divides into two stems that further subdivide. Primitively the branches go toward the postero-apical angle, while in more specialized forms they attempt to parallel the posterior margin. At times cubitus is apparently reduced to a single oblique stem. When the media and cubitus are fused basally, their branches are usually oblique. The plical furrow is definite, arcuate, at times subangulate apically and reaches the margin at or beyond the end of the subcosta. The anal area has diagonal, simple veins, more numerous in the primitive tribes. Intercalated veins may or may not be present.

The wings have the preaxillary lobe moderately developed, while the anal lobe shows considerable variation. In the primitive tribes it is not produced, much as in the Blattinae; it enlarges progressively until it is as produced apically as is the preaxillary lobe, comparable to

the condition found in some of the tribes of the Epilamprinae. In addition, it also increases in area as in that subfamily. The plical notch is primitively present, but is lost when either an interplical field or an intercalated triangle is developed. The subcosta is usually simple, rarely with a terminal fork (Parcoblattini) or clubbed (*Euphyllodromia*); at times it is stalked basally with  $R_1$ . It reaches the margin between the basal third and the middle.  $R_1$  is distinct, varying from simple to having a number of anterior rami. In the primitive tribes it has the greater number of rami and is longer. The radial sector has spaced, regular, simple anterior rami; at times these are clubbed. Apical rami, either simple or branched, are always present. A distinct apical posterior branch which may be simple, branched or with terminal twigging is usually present, but at times it is not differentiated. The arculus is always strong, usually vertical and the media usually apparently rises from its top. This vein is simple, straight to subsigmoid. The cubitus primitively has a number of branches and these are greatly reduced in the more specialized tribes. In some tribes basal twigging, and some branches going to the first plical vein, are present. In these cases about one-half or more of the branches go to the apical margin. In the more advanced tribes there are from two to five branches, all of which go to the apex. The first plical vein is either straight or upcurved apically, at times fusing with one of the cubital branches. The second plical vein varies from long to rather short and its apex is usually free. The third plical vein is distinct from the branched axillary and is either straight or downcurved apically. The branched axillary is distinct from the other veins, and usually has four and at times five branches. There are from seven to more than twelve simple anal veins. At least two series of cross-veins, usually more, are present in the anal area. Intercalated veins may be present.

This subfamily may be divided into the following tribes: Parcoblattini, Eustegastini, Euphyllodromini, Ischnopterini, Euandrobblattini, Neoblattellini, Pseudomopini, Blattellini, Supellini, Symplocini and Baltini.

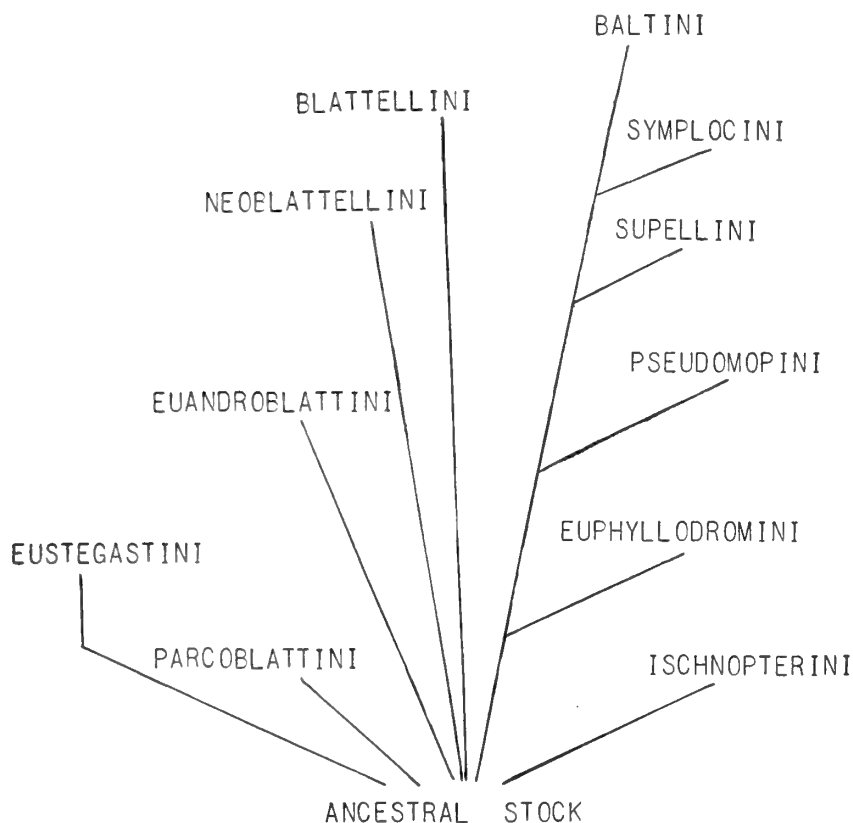


Diagram 5.—Probable relationship of the components of the Pseudomopinae.

#### Parcoblattini

This tribe appears to be the most primitive in the group, having a number of features found in other subfamilies, but also having the basic features which are further developed in the more modified tribes. The tegmina retain the rami of the subcosta, a feature found elsewhere only in the Ischnopterini, but common in the Blattinae and epilamproids. The radius has branched apical rami and a branched apical posterior branch as in some Neoblattellini, Supellini and other tribes. The distinct four-branched media is the basic type for the subfamily. The cubitus is divided into two stems and has a number of oblique sectors like those in the Ischnopterini. The plical furrow is angulate

apically or at least more strongly rounded apically, as in the *Pseudomopini*, *Symplocini* and some other tribes.

The wing has the subcosta forked apically, a condition not normally occurring in this subfamily. The radius is in general like that of the *Ischnopterini*, except that there is a simple apical posterior branch. The cubitus has six branches that go to the apex and some of these branches secondarily divide, a unique condition in this subfamily. There is some basal twigging as in the *Eustegastini*. The plical notch is present and the plical veins are much as in the *Euphyllodromini*.

The tegmina vary from relatively long (male) to rather short (female). The subcosta has spaced, regular rami in its apical half, and a simple posterior branch may be present. The anterior radial rami are rather regular, at times branched and the branched apical rami may have terminal twigging. The branched apical posterior branch shows terminal twigging. The distinct media has four long branches which may show terminal twigging. The cubitus has five or six simple branches that go to the postero-apical angle. The plical furrow is strong, more angulate apically in the male. Some of the few anal veins may rarely branch.

The wings have, for the subfamily, a relatively small anal lobe and the plical notch is indicated. The subcosta reaches the margin at the basal third and is forked terminally.  $R_1$  has a series of regular rami reaching the margin in the middle third. The radial sector has branched and simple anterior rami in addition to the branched apical rami. A relatively short, simple apical posterior branch is present. The media is stalked basally on the radius, and is sigmoid in its free portion. The cubitus has a series of branches, almost all of which go to the apical margin. Some secondary branching is present and in addition, there are a few short basal spurs. The first plical vein is not complete and is slightly upcurved apically. The second plical vein is straight and incomplete. The third plical vein is free and straight to the margin behind the plical notch. The branched axillary is distinct and has five branches, the more anterior of which may show terminal twigging. In addition, there are about a dozen simple anal veins.

It is believed that a considerable number of genera may be placed in this tribe.

Representative figured: *Parcoblatta pensylvanica* (De Geer) figs. 54, 55, 121. [Det. Hebard.] This species is the genotype. Male. Havana, Illinois. Female. Ivy Hill, Mount Airy, Pennsylvania.

#### Eustegastini

The Eustegastini is a very distinctive group based on the typical genus and is another tribe having strong Epilamprinae tendencies. The tegmina have the radius much as in the Symplocini and Blattellini except that it is sigmoid and the apical posterior branch is simple. The media is free and three-branched. Anterior to this are two veins that lack basal connections, but probably represent additional branches. Thus, media may have more branches than usual for the subfamily and these all go to the margin before the apex, a distinctive condition. The cubitus has numerous branches rising at an angle, somewhat as in the Pseudomopini, but the anterior stem has secondary branches instead of being simple. The plical furrow is evenly arcuate as in some other tribes, and the anal field has more veins than is usual in this subfamily.

The wings have a simple subcosta as in most of the complex.  $R_1$  has the rami more numerous than in the other groups, but slightly more so than in the Ischnopterini. The radial sector has only apical rami, a distinctive condition. The cubitus has four branches going to the apex and at least four short branches going to the plical fold, in addition some basal stubs are present, somewhat as in Ischnopterini, Parcoblattini and some Epilamprinae. The first plical vein is slightly upcurved apically as in many tribes. A plical notch is present as in the Parcoblattini and certain other groups, while the branched axillary has only three branches. This vein is less distinct from the other anal veins than is usual, which is much like the condition found in the Ischnopterini.

The tegmina have a simple relatively heavy sigmoid subcosta.  $R_1$  is not differentiated and there is a series of spaced, regular anterior radial rami. The radius is definitely sigmoid and has a few apical rami, more anterior than in other tribes. A relatively long simple apical posterior branch is present. The media is strongly curved and has three equal, simple branches. Two simple veins without basal connections are anterior to it and probably represent additional branches. All of these go to the margin before the extreme apex. The cubitus

divides near the base and the anterior branch subdivides. The other stem has a series of simple branches that rise at obtuse angles, and that more or less parallel the posterior margin. The plical furrow is evenly and strongly arcuate. A considerable number of simple anal veins are present. Intercalated veins are present in the radial and cubital areas.

The wings have the anal lobe moderately developed, not produced apically and the plical notch is evident. The subcosta is simple, subparallel to the anterior margin which it reaches slightly before the middle.  $R_1$  is long with ten simple, spaced rami and the radial sector has a few simple apical rami and a relatively long, simple, apical posterior branch. Media apparently rises from the top of the arculus and is almost straight. The cubitus has four simple, relatively long branches that go to the margin, then four shorter branches going to, or almost to, the first plical and some short basal stubs. The first plical vein is slightly upcurved apically. The second plical vein is moderate in length and ends in the first plical. The third plical vein is not far removed from the branched axillary, and is slightly downcurved apically. There are apparently three simple branches to the axillary, followed by nine simple veins. Intercalated veins are present throughout the wing.

Only the typical genus is placed in this tribe.

Representative figured: *Eustegasta poecila* (Schaum) figs. 63, 127. The genotype is *Epilampra buprestoides* Walker [= *Eustegasta buprestoides* (Walker)]. Male. Amani, "German East Africa" [= Tanganyika Territory].

#### Euphyllodromini

The Euphyllodromini are a small complex that resembles the Ischnopterini in many features. The tegmina have the radius and media as in that group and the Euandroblattini, except that the media is reduced to two or three branches. The cubitus is from two to four branched; these branches tend to parallel the posterior margin and are somewhat angulate basally, reminiscent of the condition found in the Euandroblattini.

In the wings, the subcosta is free or stalked on  $R_1$ , simple or clubbed, much as in the Ischnopterini and *Euandroblattata*.  $R_1$  is simple as in many of the specialized groups. The radial sector has regular



spaced rami which may be clubbed, as in the Supellini and some Neoblattellini. Apical rami and an undifferentiated apical posterior branch are as in the latter tribe. The cubitus has two or three branches as in the Supellini and Blattellini. The first plical vein is straight or upcurved apically and the third is straight, agreeing on one hand with the basic type and on the other with the Neoblattellini and other forms with an incipient or actual intercalated triangle.

The tegmina have the subcosta heavy, straight or almost so, and shorter than the anal field.  $R_1$  is not differentiated and there is a series of regular, spaced, rami that continue to the apex. Rarely these are branched. The apical posterior branch is not differentiated. The media has two or three long, simple branches that attempt to parallel the posterior margin. The cubitus parallels the plical fold basally and has either two or four simple branches that more or less parallel the posterior margin. The plical furrow is weakly arcuate, at times subangulate apically. A few simple anal veins pass diagonally across this field.

The wings have moderate to well-developed anal lobes, in the latter case produced as much as the preaxillary lobe. A small area, apparently comparable to the intercalated triangle, is present in *Chromatonotus*, but no trace of folding is noticeable. In *Euphyllodromia* this area is not specialized. The subcosta may be free and clubbed, or, it is stalked on  $R_1$  basally.  $R_1$  is distinct and may be clubbed. The radial sector has a series of spaced rami which may be clubbed; simple apical rami are present and an apical posterior branch is not differentiated. The media is stalked for a short distance on the radius and its free portion is either straight or sigmoid. The cubitus has either two or three simple branches that go to the apex. The first plical vein is either incomplete or upcurved apically. The second plical vein is long and free apically. The third plical vein is straight or nearly so. The branched axillary is moderately close to the third plical vein and has four simple branches. In the forms with an upcurved first plical the terminal branch of the axillary is downcurved; these two veins mark off an area equivalent to the intercalated triangle of some tribes. At least ten simple anal veins are posterior to the branched axillary.

In addition to the genera studied, it seems probable that other forms may be placed in this tribe.

Representatives figured: *Chromatonotus lamprus* Hebard figs. 56, 122. [Det. Hebard, Paratype.] This species is the genotype. Male. Corozal, Canal Zone, Panama.

*Euphyllodromia angustata* (Burmeister) figs. 57, 123. [Det. Hebard, 1919.] This species is the genotype. Female. Gatun, Canal Zone, Panama.

#### Ischnopterini

The Ischnopterini are another primitive tribe that shows some relationship to the Epilamprinae. The tegmina have the subcosta proportionately shorter than in the other tribes and they have short anterior rami, which are also found in the Parcoblattini. The radial rami are regular basally and irregular apically; no distinct apical rami or apical posterior branch is present, resembling in those respects the Euphyllodromini and to some extent the Pseudomopini. The media is free and four branched as in the Parcoblattini, and the numerous cubital sectors are arcuate as is that tribe and some Euphyllodromini and Neoblattellini. The plical furrow is rounded as in the Neoblattellini and some other tribes.

The wings somewhat resemble those of the Eustegastini and some Epilamprinae. The subcosta is stalked on  $R_1$  as in some other tribes, but  $R_1$  has more rami than any other tribe except the Eustegastini. The radius is essentially as in the Euphyllodromini. The cubitus has four branches which go to the apex and five which go to the plical furrow, much as in the Eustegastini, but lacking the basal stubs found in that tribe. The first plical vein curves forward apically, and the third plical curves posteriorly, marking off a small interplical field as in the Supellini.

The tegmina are elongate and the plical notch is evident. The subcosta is relatively short and has a few short, apical rami.  $R_1$  is not differentiated and the radial sector has a series of regular, spaced, usually simple rami that continue to the apex; no apical posterior branch is present. The media has four long simple branches. The cubitus divides regularly and has six branches that go diagonally toward the postero-apical angle. The plical furrow is regularly arcuate. The anal field has simple diagonal veins.

The wings have the anal lobe moderately produced, shorter than the preaxillary lobe, and a small interplical field is present. The subcosta is stalked on  $R_1$ , its free portion is sinuate.  $R_1$  has a series of spaced rami and it ends beyond the middle. The radial sector parallels  $R_1$  and past it has anterior rami, the more apical ones branched, and a few simple apical rami. An apical posterior branch is not differentiated. The media is simple and sigmoid. The cubitus has four simple apical branches that go to the margin; basally there are four branches that go to the first plical area. The first plical vein is upcurved apically. The second plical vein is relatively long, ending free before the curving of the other plical veins. The third plical vein is but moderately removed from the branched axillary and is downcurved apically. The branched axillary has four long simple branches, and posterior to it are at least a dozen simple anal veins.

Although only the typical genus is placed in this tribe at this time, it is believed that a considerable number of genera are closely related to it and may be placed in this group.

Representative figured: *Ischnoptera rufa rufa* (De Geer) figs. 62, 126. [Det. Hebard.] The genotype is *I. morio* Burmeister. Female. Barro Colorado, Canal Zone, Panama.

#### Euandroblattini

The Euandroblattini represents another distinctive, but primitive type of Pseudomopinae. The tegmina are proportionately broader than in any of the other tribes and their subtruncate apex is also distinctive. The radius is much as in the Euphyllodromini and Ischnopterini, except that the more apical rami are regularly divided. The media is four branched as in the latter tribe and the Parcoblattini. The cubitus has its few branches parallel to the posterior margin and angulate basally, reminiscent of the condition found in the Symplocini and comparable to the cubital stem in *Euphyllodromia*. The plical furrow is evenly arcuate as in most of the higher Pseudomopinae.

The wing has a much larger anal fan than in most of the other tribes, but it is not produced apically, being shorter than the preaxillary lobe. The radius is more like the primitive condition and that found in the Epilamprinae, than like most Pseudomopinae, having fewer and more irregular rami. The cubitus has five branches suggesting the

condition found in the Parcoblattini, but does not have the basal twigging found in that tribe. A distinct plical notch is present and the first and third plical veins are straight as in the Pseudomopini and Parcoblattini, and the second plical vein is long and free.

The tegmina are proportionately short and relatively broad and the apex is subtruncate. The plical notch is well developed. The subcosta is shorter than the anal field, sinuate and heavy basad.  $R_1$  is not differentiated, but the first radial ramus is close to the subcosta. The radius has spaced, simple rami in its basal half, apically these and the apical rami subdivide. A definite apical posterior branch is not present. The media has four, long simple branches that practically parallel the posterior margin. The cubitus basally parallels the plical furrow, and then has four long branches that parallel the posterior margin. The plical furrow is strong, almost evenly arcuate. The anal field has a number of simple diagonal veins.

The wings have a larger preaxillary and anal lobe than is usual in the subfamily, but the latter is not produced apically. A shallow plical notch is present. The subcosta is stalked on radius and  $R_1$ , but its apex is free and simple.  $R_1$  after becoming free goes to the margin beyond the middle; its apex is forked. The radial sector has a few branched apical rami. A definite apical posterior branch is not present. The media apparently rises from the top of the arculus and it is practically straight. The cubitus has five, long, simple, arcuate branches that go to the apex. The first plical vein is almost complete, practically straight. The second plical vein is relatively long and its apex is free. The third plical vein is remote from the branched axillary and is straight. The branched axillary has five, long, simple branches and posterior to it are ten or more simple anal veins.

Only the typical genus is placed in this tribe.

Representative figured: *Euandrobatta curta* (Walker) figs. 61, 124. [Det. J. A. G. Rehn, 1937.] The genotype is *Euandrobatta prospera* Rehn. Male. Kisantu, Lower Congo District, Belgian Congo.

## Neoblattellini

The Neoblattellini show considerable diversity, but those forms studied all seem to be representatives of a single stock. In the tegmina the subcosta is as long as the anal field, a condition found only in the highly modified tribes. The radius is much like that of the Paracoblattini and Euphyllodromini. This tribe resembles the Supellini and Blattellini in having a distinct area without venation between the radius, and the fused media and cubitus. The apical branches of this latter combination continue to the apex, as in the Blattellini, and are not oblique to the posterior margin as in the Supellini. The plical furrow is somewhat angulate, but not as strongly so as in the primitive Pseudomopinae.

The wings have  $R_1$  well differentiated, not branched as in the Baltini and Euphyllodromini, but often clubbed. The radius has anterior and apical rami and an apical posterior branch much as in the Paracoblattini, but the anterior rami are often clubbed as in the Supellini and some Euphyllodromini. The cubitus is four or five branched, thus intermediate between the primitive Paracoblattini and Ischnopterini and the advanced forms such as the Supellini, Symplocini and Pseudomopini. The first plical vein curves forward apically as in some other tribes, and the third plical is straight to the margin, often supporting an intercalated triangle as in the Baltini. The base of the third plical vein is rarely lost, a condition not noted elsewhere.

The tegmina are elongate and have the plical notch but moderately indicated. The subcosta is almost straight, heavy and as long as the anal field.  $R_1$  is not differentiated and the radial sector has spaced, rarely branched anterior rami. A few branched apical rami are present and the apical posterior branch is not well differentiated. The media is fused with cubitus, so that no distinction can be made between their four to eight major branches. The more terminal branches are straight and go to the apex and the others may be arcuate and go to this margin, or be oblique and go to the posterior one. Some secondary division and terminal twigging is noted. The plical furrow is either arcuate or weakly angulate. A few simple, diagonal veins are present in the anal field.

The wings have a moderately large anal lobe and the plical notch may be indicated or not. An intercalated triangle is often present.

The subcosta is a simple vein that may be stalked on the radial system.  $R_1$  is more or less parallel to the subcosta and may be clubbed. There are a number of spaced, regular, often clubbed anterior radial rami. Branched apical rami and a branched apical posterior radial branch are present. The media is usually simple, rarely with a terminal fork, and practically straight. The cubitus shows considerable variation, but has four or five major branches that go to the apex. Rarely these branches may subdivide or have terminal twigging and at times basal stubs are present on the main stem. The first plical vein is upcurved apically, at times fused with one of the cubital branches. The second plical vein is relatively long and its apex is free. The third plical vein is straight, rarely its base is subobsolete. This vein supports the intercalated triangle that is often present. The branched axillary is remote from the third plical and has at least four branches. Fourteen or more veins reach the margin of the full anal field.

In this tribe, all conditions from an expanded veinless area on either side of the apex of the third plical vein to a definite intercalated triangle are observed. The margin of the anal field bounding the branched axillary may be either evenly arcuate or slightly produced. This latter condition resembles, to some extent, that found in the *Ceuthobiinae*.

It is believed that in addition to the genera now placed in this tribe, a considerable number of forms may be eventually included.

Representatives figured: *Aglaopteryx gemma* Hebard fig. 59a. [Det. Hebard, Paratype.] This is the genotype. Female. Mobile, Alabama.

*Caribblatta delicatula* (Guérin) figs. 58, 125. [Det. Hebard, 1924.] This is the genotype. Male. Montego Bay, Jamaica.

*Latiblattella rehni* Hebard figs. 60, 129. [Det. Hebard, Paratype.] This is the genotype. Male. Cocoanut Grove, Florida.

*Neoblattella fratercula* Hebard figs. 59, 128. [Det. Hebard.] The genotype is *Blatta adspersicollis* Stål [= *Neoblattella adspersicollis* (Stål)]. Male. Lancetilla, Honduras.

#### Pseudomopini

The Pseudomopini, the typical tribe of the subfamily, are a distinct entity showing both extreme specialization in some respects and, on the

other hand, a retention of primitive features. The tegmina have the subcosta simple and the radius has only anterior rami as in the Euphyllodromini and Ischnopterini. The media is simple, arcuate and very heavy based, a distinctive condition. Cubitus has a simple anterior branch equivalent to one of the stems in other tribes, and the posterior stem has five branches that are crowded basally and rise at an angle, a condition not found in any other tribe. The Euandroblattini and Eustegastini have a different type of an angulation in the cubital branches. The plical furrow is angulate apically as in the Parcoblattini, Blattellini and some other tribes.

The wings have a moderately long, simple subcosta as in the Supellini and Symplocini.  $R_1$  is distinct and with terminal forks as in the Supellini and Blattellini. The radius is well developed, having numerous regular anterior rami as in the Euphyllodromini and Blattellini. A short apical posterior branch is present, but not well differentiated. The cubitus has three branches as in the Supellini. The third plical vein goes straight to the apex, and a definite plical notch is present as in the Euandroblattini and Eustegastini.

The tegmina are elongate and slender, more so in the apical two-thirds. The plical notch is evident. The subcosta is a little shorter than the anal field, relatively heavy, simple and subangulate basally.  $R_1$  is not differentiated. The radius is very heavy basally and is strongly sigmoid, an apical posterior branch is not differentiated. There is a complete series of regular, spaced, simple anterior rami, the more proximal ones slightly thickened. The media, which is simple and heavy basad, parallels the radius and is therefore sigmoid. The cubitus which basally parallels the plical furrow has a remote, simple, curved anterior branch that appears to represent the anterior stem. There are five branches that rise at a strong angle from the posterior stem. These branches become further apart apically and all go to the tegminal apex. The plical furrow is strong, definitely angulate apically. There are a small number of curved, simple anal veins.

The wings have a well-developed preaxillary lobe and a relatively small anal lobe. The plical notch is very distinct. The subcosta is relatively long, reaching the margin slightly before the middle, simple and straight.  $R_1$  parallels the subcosta and has a few simple terminal

rami. The radial sector has a series of regular, simple, spaced anterior and apical rami. An apical posterior branch is not differentiated. The media rises from the apparent top of the arculus and is almost straight. The cubitus has three long, simple, straight branches that go to the apical margin. The first plical vein is straight and complete. The second plical vein is relatively long and it ends in the first plical. The third plical vein is straight to the plical notch. The branched axillary is remote from the third plical and apparently has five simple branches. More than ten veins reach the margin in the anal area.

Only the typical genus can be placed in this tribe at the present time.

Representative figured: *Pseudomops intercepta* (Burmeister) figs. 64, 137. [Det. Hebard, 1926.] The genotype is *Blatta oblongata* Linnaeus [= *Pseudomops oblongata* (Linnaeus)]. Male. Cuernavaca, Mexico.

#### Blattellini

The Blattellini is a distinct tribe that has an unusual combination of features. The tegmina resemble those of the Neoblattellini by having essentially the same type of radius, except that the apical posterior branch is very long. The media and cubitus are fused and possibly the cubitus is reduced to the single posterior branch. This is much as in the Baltini, except the branches go to the apex as in some Neoblattellini, instead of to the posterior margin. The plical furrow is subangulate apically as in the Parcoblattini.

The wing has the subcosta and radius much as in the Symplocini but the cubitus has only two branches, instead of three or more branches as in other tribes, which is distinctive. The second plical vein is shorter than in any of the other members of this subfamily, and terminates in the first plical vein as in the Pseudomopini. The plical notch is not definitely indicated and there is no trace of a special field in this area, another distinctive combination of features.

The tegmina are relatively elongate and the subcosta, which is shorter than the anal field, is heavy, simple and almost straight.  $R_1$  is not differentiated and the radial sector has simple, spaced anterior rami, the most apical of which may branch. A few apical rami, either simple or branched, are present. There is a distinct apical posterior



branch that is equal to one-third of the tegminal length, and that has terminal twigging. The media and cubitus are fused so that it is not possible to separate their six long branches that go to the apex. The most basal branch is remote, more or less paralleling the plical furrow and may represent a single unbranched cubitus. The plical furrow is distinct, subangulate apically. A very few simple veins, most of which are oblique, are present in the anal area.

The wing has the preaxillary lobe relatively narrow and the anal lobe is moderately produced, bounding the branched axillary. A definite plical notch is not evident. The subcosta is simple and the distinct  $R_1$  has simple terminal rami. The radial sector has regular, simple, spaced anterior and apical rami. The apical posterior radial branch is equal to one-third the wing length and has terminal branches. The media, which is fused for a short distance with the radius, is almost straight. The cubitus parallels the media and has two simple apical branches that are but a little shorter than the apical posterior radial branch. The first plical vein is weakly upcurved in its apical portion. The second plical vein is shorter than the subcosta and ends in the first plical. The third plical vein is straight. The branched axillary is well removed from the third plical and has four, long, simple branches. Posterior to those there are ten simple anal veins.

It would seem that a considerable number of forms may be referred to this tribe when further studies are made.

Representative figured: *Blattella germanica* (Linnaeus) figs. 66, 136. [Det. Hebard.] This is the genotype. Male. Key West, Florida.

### Supellini

The Supellini are a distinct tribe of the Pseudomopinae, but show some of the characteristics of the Ectobiinae. Forms varying from fully alate to greatly reduced are members of this tribe. The discussion is based fundamentally on the fully alate forms; those showing reduction have as a whole a simplification of the basic plan. The tegmina have regular anterior and variable apical radial rami, and the apical posterior branch is much as in the Neoblattellini. The media and cubitus are fused indistinguishably, with oblique branches all of which go to the posterior margin, as in the Baltini, and differing from

the Neoblattellini in which at least some of the branches go to the apex. The very distinct space between the radius and the medio-cubital system, with oblique sectors anterior and posterior to it, is a condition only noted elsewhere in some of the Chorisoneurinae, but it is indicated in the Baltini. The apically angulate plical furrow is much like that of the primitive Pseudomopinae.

The wing has a relatively small anal lobe, and the plical notch is not indicated, much as in *Euphyllodromia* and the Blattellini. There is a long simple subcosta as in some Neoblattellini.  $R_1$  is more developed, as in the Blattellini, but has its rami clubbed as in some Neoblattellini. The radius has only a few anterior rami, less than in other tribes, the apical rami and the apical posterior branch are much as in the Parcoblattini and Pseudomopini. A three-branched cubitus, shows a relationship with other forms, such as the Blattellini, Neoblattellini, Euphyllodromini and Pseudomopini. The first plical curves forward apically and the third curves posteriorly as in the Ischnopterini.

The tegmina are usually elongate, when reduced more or less obovate. The plical notch is not noticeable. The subcosta is simple, slightly curved and may be somewhat thickened. It is a little shorter than the anal area. The radius does not have a distinct  $R_1$ , but has regular, spaced, simple anterior rami. In those forms not showing reduction, simple or branched apical rami are present and there is a distinct, branched apical posterior branch. The media and cubitus are indistinguishably fused, leaving a narrow strip that goes from the base to the apex without venation, between them and the radius. The fused medio-cubitus has a number of regular, usually simple, oblique branches that all go to the posterior margin. The most basal branch, in the reduced forms, is more or less parallel to the plical furrow. The plical furrow is distinct and may be subangulate apically. There are a few simple oblique veins in the anal field.

The wings have a moderately developed preaxillary lobe and a relatively small anal lobe. The plical notch is not evident. The subcosta is long and simple, reaching the margin near the middle.  $R_1$  more or less parallels the subcosta and has clubbed apical rami. The radial sector has a branched, clubbed anterior ramus, and then some simple rami followed by a branched apical ramus. The apical posterior radial branch is short and has a terminal fork. The media apparently rises

from the top of the arculus and is almost straight. The cubitus has three simple almost straight branches that go to the apex. The first plical vein curves forward apically. The second plical vein is of moderate length and its end is free. The third plical vein is down-curved apically. The apices of the first and third plical veins mark off a small intercalated field, which is much like that found in some of the *Epilamprinae*. The branched axillary is remote from the third plical vein and usually has four simple branches. There are at least six simple anal veins posterior to it.

It seems probable that a number of genera may be referred to this tribe in the future.

Representatives figured: *Ceratinoptera picta* Brunner figs. 69, 140. [Det. Hebard, 1920.] This is the genotype. Female. Gatun, Canal Zone, Panama.

*Supella supellectillum* (Serville) figs. 67, 131. [Det. J. A. G. Rehn, 1940.] This is the genotype. Male. Fort Leavenworth, Kansas.

#### Symplocini

The Symplocini are another tribe that have a combination of distinctive features. The tegmina have the radius much as in the *Blattellini*, but the apical posterior branch is more elongate, equal to more than one-half the tegminal length, a distinctive feature. The anterior radial rami are somewhat thickened as in the *Baltini*. The media is free as in the primitive tribes and has three branches as in *Chromatonotus*, while the cubitus divides into two stems with their branches paralleling the posterior margin somewhat like the condition found in *Euphyllodromia* and the *Euandroblattini*. The plical furrow is angulate-apical as in the *Parcoblattini*, *Blattellini* and *Pseudomopini*.

The wings have a large anal lobe, almost as full as that of the *Euandroblattini*. The third plical vein is straight to the apex and supports a small plical field, but it is not developed into an intercalated triangle as in the *Neoblattellini*. The subcosta and radius are much as in the *Blattellini*, but the apical posterior radial branch is longer. The cubitus has four branches going to the apex and some basal twigging, the latter resembling the condition found in the *Parcoblattini* while the former is as in the *Neoblattellini*. The first plical vein curves forward apically as in many tribes. There is an accessory vein between

the third plical vein and the posteriorly curved first branch of the axillary, a condition not noted in any other members of the subfamily.

The tegmina are elongate and somewhat broader than is usual. The plical notch is scarcely indicated. The subcosta is relatively heavy, simple, straight and shorter than the anal field.  $R_1$  is not differentiated and the radial sector has a series of simple spaced anterior rami. A few mostly branched apical rami are present. The apical posterior radial branch, which has apical branches, is very distinct and is equal to more than one-half the tegminal length. The media is somewhat arcuate and has three simple branches. The cubitus divides into two stems, the more anterior subdivides, and the posterior after paralleling the plical furrow has three branches. The branches of cubitus and media all parallel the posterior margin. The plical furrow is arcuate, subangulate apically. There are a few simple anal veins.

The wings have the anal lobe large and as produced apically as the preaxillary lobe. There is no plical notch. A small field is developed around the apex of the third plical vein, but a definite intercalated triangle is not present. The subcosta is simple, reaching the margin slightly before the middle.  $R_1$  is very distinct; it parallels the subcosta and has a short series of simple spaced anterior rami. The radial sector has a few simple anterior rami and branched apical rami. The apical posterior radial branch is equal to one-half the wing length and shows terminal twigging. The media rises from the apparent top of the arculus and is weakly sigmoid. The cubitus more or less parallels media and has four simple branches that go to the apex. The more posterior of these branches are curved forward apically. Some short stubs may be present on the cubital stem. The first plical vein is strongly upcurved apically. The second plical vein is long, ending just before the first plical curves, and its apex is free. The third plical vein is straight. The branched axillary is remote from the third plical and apparently has six simple branches, the most anterior of which curves downward apically, while this branch and the first plical bound a small field around the apex of the third plical vein. Apically between that vein and the axillary is an intercalated vein. Posterior to the branched axillary there are at least a dozen simple veins.

It is not known how many other genera may be included in this tribe.

Representative figured: *Symploce capitata* (Saussure) figs. 65, 130. [Det. Hebard.] This species is the genotype. Male. Havana, Cuba.

### Baltini

The Baltini are related to both the Neoblattellini and the Supellini, all apparently being derived from a common ancestor, but are in some ways more advanced than these other tribes. The tegmina have the subcosta long as in these tribes, but the anterior rami of the radius are weakly clubbed, which appears to be distinctive. The apical posterior branch has secondary branches, stronger than in any of the other tribes; but somewhat like those in *Latiblattella* and the Parcoblattini. The media and cubitus are fused and their branches are oblique, angling toward the postero-apical angle, somewhat as in the Supellini. Intercalated veins are present throughout the tegmina, a condition not common in other tribes.

The wings are much like those in the Neoblattellini except that the radial rami are never clubbed, and the apical rami and apical posterior branch are not as developed. The second plical vein goes at least to the inner margin of the intercalated triangle, not shorter as in the Neoblattellini. The intercalated triangle is well developed and in folding it crosses the first branch of the axillary, a distinctive feature. The number of crossveins in the anal field is somewhat reduced, but not to one or two series as in the forms with an appendiculate field.

The tegmina are shorter and broader than in the other tribes, and gradually narrow apically. The plical notch is definite. The subcosta is simple, almost straight, and is as long as the anal field.  $R_1$  is longer, more oblique and thickened than the anterior rami. The radial sector has a series of spaced, usually simple, somewhat clubbed anterior rami. Branched apical rami, and a branched, long, apical posterior branch are present. The media and cubitus are fused and have six oblique branches that go to the posterior margin. The proximal branch basally, parallels the plical furrow. A veinless area is between the medio-cubitus and the radial system, but it is less distinct than in the Supellini. The plical furrow is strong, definitely angulate apically. The anal field has a few oblique, curved veins, the most posterior of which is branched.

The wing has a large anal lobe that is as produced as the preaxillary lobe. The plical notch is absent and there is a well-developed intercalated triangle, which is bounded anteriorly by the first plical vein and posteriorly goes to the area between the apex of the first and second branches of the axillary. The apex of the third plical vein forms most of its support, but the apex of the first branch of the axillary, and at times the apex of the second plical vein, are in this field. The subcosta is long and simple, reaching the margin slightly beyond the middle.  $R_1$  is simple and closely parallels the subcosta. The radial sector has a series of simple spaced anterior rami. Simple or branched apical rami are present and the apical posterior branch is not well differentiated. The media rises from the apparent top of the arculus and is simple and straight. The cubitus has four long simple branches that go to the apical margin. The apex of the most posterior branch may fuse with the first plical vein which is upcurved apically. The second plical vein is long, ending at or in the intercalated triangle, its apex free. The third plical vein, which is remote from the branched axillary, is straight and is the main support for the intercalated triangle. The branched axillary has four long simple branches. Posterior to this are seven or more simple anal veins.

It is believed that additional genera may be placed in this distinctive tribe.

Representative figured: *Balta similis* (Saussure) figs. 68, 138. [Det. Hebard, 1925.] The genotype is *Balta epilamproides* Tepper. Female. Kauai Island, Hawaii.

#### ECTOBIINAE

To this subfamily belong all those forms having an appendiculate field supported only by the third plical vein, except the Anaplectinae. In many respects, the group appears to be most closely related to the Pseudomopinae. The tegmina have many features in common with that group such as the fusion, at least at times, of media and cubitus so that they cannot be differentiated. From the Anaplectinae, this subfamily may be separated by having the subcosta simple and equal in length to the anal field, and the less strongly arcuate plical furrow. Also, the presence, except in the Plectopterini, of an apical posterior radial branch, and the branches of media and cubitus going obliquely

to the posterior margin, further differentiated this subfamily from the other forms with an appendiculate field.

The wings while different from those of the Pseudomopinae show certain basic similarities. All included genera have an appendiculate field, usually set off by a transverse fold. The genus *Ectobius* has the appendiculate field crumpled in repose and lacks the distinctive transverse fold. This field is entirely supported by the third plical vein as in the Anaplectinae. It seems that this might be a development from some type such as *Balta*, which has an intercalated triangle supported by the third plical vein. The wings lack an apical posterior radial branch which is present in the Anaplectinae. The apical fusion of the main veins to bound basally the appendiculate field, the more numerous crossveins in the preaxillary portion of the wings, and the presence of a complete first plical vein further differentiate this subfamily from the Anaplectinae.

The tegmina are either elongate lanceolate or subtrigonal in shape. The anterior margin is usually almost straight, at times somewhat arcuate. The apical margin is evenly but narrowly rounded and the posterior margin is practically straight. The plical notch is at most subobsolete. The margin of the anal field is rounded angulate, more so in *Plectoptera* than in other members of the group. The humeral area is but moderately developed. The subcosta is a relatively heavy, simple vein about equal in length to the anal field. It is usually almost straight, rarely sigmoid. The radius is heavy basally and usually extends to the extreme apex. It has fairly regular, spaced, anterior rami, some having secondary divisions. In all but the Plectopterini an apical posterior branch or branches may be present. The development of this feature varies considerably in individuals and in series of some species. These branches may go to the tegminal apex, or to the posterior margin at about the apical third. The media and cubitus may be fused basally so that it is not possible to separate them. When they can be differentiated, the media is somewhat arcuate and has three or more major branches. These curve toward the posterior margin and, at times, have secondary branches. In these cases, the cubitus more or less parallels media, and it may be simple or have up to four arcuate branches that go to the posterior margin. Rarely a simple arcuate or sinuate vein that goes to the posterior margin at about the middle of

the tegmina appears to be the cubitus. In *Plectoptera*, media and cubitus are a single stem which branches once near the middle of the tegmina. The more anterior branch goes to the apex and the other to the posterior margin. The plical furrow usually is evenly arcuate but in *Plectoptera*, it is almost straight. Usually, a trace of a plical notch is present. The anal field has at most four arcuate veins, usually the more anterior of these roughly parallel to the plical furrow, and the posterior one is more or less parallel to the anal field margin.

The wing has the distinctive appendiculate field which, except in the genus *Ectobius*, is separated by a transverse fold. In that genus, it is represented by a distinctive area that does not materially alter the wing outline. The anterior wing margin is usually sigmoid, concave basally and convex apically. The apical margin is formed by the appendiculate field and may be rounded, subcircularly produced or rounded subconical. In the latter case, the extreme apex is subobtuse angulate, while in the former it is evenly arcuate. As this field is supported by the plical vein, no plical notch is present. The margin of the anal field is regularly arcuate, occasionally somewhat angulate basally. The subcosta is simple and equal to about one-third to one-half the total wing length, reaching the anterior margin after the latter has become convex. Apically, it may be forked. The radius is well developed and extends to the edge of the appendiculate field. A number of anterior rami are present which are usually regular, rarely showing some secondary branching. An apical posterior branch is not present. The base of media is either not evident or this vein is stalked on the radial system. Media is usually straight or gently arcuate, curving forward apically toward the radial sector. The area between these two veins is divided into regular or irregular cells by crossveins. The arculus is strong, either inclined or vertical. Cubitus is unbranched and somewhat sigmoid, and after passing the arculus is more or less parallel to media. The cubitus is upcurved apically and joins the media. The first plical vein rises near the base of cubitus, usually curves posteriorly and then more or less parallels that vein. Apically this vein curves forward to the cubitus. Thus, in all cases, the first plical, cubitus, media and radius are joined or attempt to join apically and form a portion of the inner boundary of the appendiculate field. The second plical vein is strong, extending from slightly less than half



to almost two-thirds the wing length, and ends free. The third plical vein is free basally, practically straight to the appendiculate field, crosses the fold and continues to the apex of this field, except in *Ectobius*. The entire appendiculate field is supported by this vein. The branched axillary has its base distinct from the third plical and normally has two or three branches. In all cases, these first two branches join apically and delimit the inner margin of a portion of the appendiculate field. In most cases, the third plical vein is joined to the branched axillary by one or more crossveins. Behind this, there are eight to eleven simple anal veins. Usually, there is a single series of crossveins in the anal area. Rarely, these are absent, as in some specimens of *Chorisoneura*, or they may be double in the anterior portion of the field, a condition which has been noted in *Ectobius*.

In this subfamily after the anal fan has folded, fanwise, the wing folds along a line anterior to or on part of, the third plical vein. Then the appendiculate field folds over on the dorsal surface of the preaxillary area. In *Ectobius* the appendiculate field is crumpled and lies in the same relative position. In this subfamily, a definite transverse fold, either vertical or oblique, usually separates the appendiculate field from the remainder of the wing.

The three distinctive types have been examined in this subfamily and they are believed to represent separate tribes. In much of the older literature, these forms have been given subfamily or even higher rank.

The following tribes are recognized: Ectobiini, Chorisoneurini and Plectopterini.

#### Ectobiini

This tribe is erected for the typical genus and certain other genera known to share its features. The tegmina are elongate, lanceolate as in the Chorisoneurini, but have a sigmoid subcosta which is distinctive. The radius normally has a number of posterior branches, some of which pass to a considerable portion of the posterior margin, instead of having these branches restricted and mostly going to the apical margin (Chorisoneurini). The median and cubital systems are more oblique and less sigmoid than in the other tribes, and the plical furrow is more strongly arcuate. The anal field has only a few veins and these do not closely parallel the margins.

The wings may immediately be recognized by their lack of distinctive transverse fold. The appendiculate area is crumpled in repose and forms a normally rounded wing apex, not produced as in the other tribes. Moreover, the base of media is not preserved, while it is present in the other tribes. The base of the third plical vein is not preserved, and this vein after entering the appendiculate field distinctly curves posteriorly; these are again distinctive features. The branched axillary has only two branches, instead of three, and these fuse apically to limit the appendiculate field. Anteriorly in the anal field, behind the branched axillary, a second series of crossveins may be evident, a feature not found in the other tribes.

The tegmina are in general elongate oval with the humeral area moderately developed. The subcosta is heavy, simple and sigmoid. The radius basally is thickened and extends to the extreme apex; anteriorly throughout its course are a number of regular rami. In the apical half, regularly spaced posterior branches are present, which pass to the apical and posterior margins. Media is somewhat sigmoid and has four simple branches which go to the posterior margin. The cubitus appears as a single, simple sigmoid vein, it also going to the posterior margin. The plical furrow is well indicated, but there is only faint indication of the plical notch. Three simple anal veins are present.

The appendiculate field of the wing is not produced, its apical margin broadly rounded. This field evenly joins the anal field; no plical notch or angulation is evident. The subcosta is simple and slender, curving forward to the anterior margin at or before the middle. The radius is sigmoid and has regular anterior rami throughout its length, no distinct  $R_1$  or apical posterior branch is present. The base of media is lost and the remainder of the vein more or less parallels cubitus, it is upturned apically, joins the radius, and is connected with the radial sector by a number of irregular crossveins. The arcus is strong and vertical. The cubitus basally is sigmoid, then parallels media and apically curves forward to join that vein. Media and cubitus are joined by a number of crossveins which divide this area into regular rectangular cells. The first plical vein rises near the cubitus and is sigmoid, it curves forward apically to join the cubitus. These two veins are joined by crossveins, which divide the area into subrectangulate cells.

Apically, the first plical, cubitus, media and radius are joined and delimit the inner margin of the anterior portion of the appendiculate field. The second plical vein ends free and is equal to approximately one-half the wing length. The third plical vein has its base lost. It is sigmoid to the appendiculate field and in this field it curves posteriorly, going to the margin behind the middle. The branched axillary goes almost to the apical third, then branches once, terminally these branches fuse. Several crossveins connect the third plical and the branched axillary. These and the branched axillary bound the inner margin of the posterior portion of the appendiculate field. Within the cell made by the axillary branches are irregular crossveins. Eleven simple anal veins are found posterior to the branched axillary. Anteriorly, these are connected by a double series of crossveins, then a single series and finally no crossveins.

Representative figured: *Ectobius lapponicus* (Linnaeus) figs. 70, 134. [Det. Saussure.] This species is the genotype. Male. Europe.

#### Chorisoneurini

To this tribe belong, in addition to the typical genus, a number of related genera such as *Mediastinia*.

The tegmina have certain features such as the simple straight subcosta and the stem of radius not reaching the extreme tegminal apex, in common with the Plectopterini, but the shape is like that of the Ectobiini. The anterior radial rami near the apex are secondarily divided, which is distinctive of the group. The posterior branches which may subdivide are usually but not always present, and go either to the apical margin or the apical posterior angle. There is considerable variation in the development of these branches. The media and cubitus may be stalked basally as in the Plectopterini. There is considerable variation in these two systems so that only certain generalizations can be made. Whether they divide into two main stems or not, a number of branches, more than in the other tribes, that curve towards the posterior margin are present. When two stems are present, the media usually does not have less than four branches, while the cubitus may have up to that number. At times, all of these branches rise from a single stem. The plical furrow is not strongly arcuate as in the Ectobiini. The plical notch is more evident than in any of the other tribes. The anal area

has four simple veins, the more anterior paralleling the plical furrow, while the most posterior parallels the posterior margin.

The anterior wing margin is gently arcuate, not sigmoid as in the other tribes, and roundly passes into the margin of the appendiculate field. This field is subcircular in outline, and not as produced as in the Plectopterini. It meets the margin of the anal field at a distinct angle as in that group. The subcosta is equal to less than one-half the wing length and forks terminally, not simple as in the other tribes. The radius more or less parallels the subcosta and goes to the basal margin of appendiculate field. It has numerous anterior rami that are less regular than in the other tribes. The media is stalked basally on radius, resembling the condition found in the Plectopterini, and is almost straight to the apical third, then gently and arcuately curving anteriorly to join the radial system. The area between these two veins, beyond the subcosta, is divided into subrectangulate cells by crossveins. The arculus is strong and vertical. The cubitus is at first sigmoid, then more or less parallels the media, at the apex it curves anteriorly and joins the media. The first plical vein rises near the cubitus, curves posteriorly and then is almost straight to the margin of the appendiculate field where it curves forward to join the cubitus. Apically, the area between the cubitus and the first plical is divided into a few subrectangulate cells by crossveins. The first plical, media and radius are joined apically, and mark off the inner margin of the anterior portion of the appendiculate field as in the Ectobiini. The second plical vein is strong, reaching almost to the inner margin of the appendiculate field and its end is free. The third plical vein is free basally as in the Plectopterini, practically straight to the appendiculate field, and then curves forward slightly. Its apex is at the extreme apex of the appendiculate field. The branched axillary is strong and has three branches as in the Plectopterini. Apically, the first two join and form the inner boundary of this portion of the appendiculate field. The most posterior branch reaches to the margin of the anal field. Nine simple anal veins are behind the branched axillary. In at least some instances, a crossvein connects the third plical with the branched axillary apically. At times, a series of crossveins is found in the anal field.

Representative figured: *Chorisoneura flavipennis* (Saussure and Zehntner) figs. 71, 135. [Det. Hebard, 1921.] The genotype is

*Blatta nigrifrons* Serville [= *Chorisoneura nigrifrons* (Serville)].  
Male, female. Venvidio, Sinaloa, Mexico.

Plectopterini

This is another tribe of the Ectobiinae, which in many respects is very distinct.

The tegmina in general are elongate subtrigonal, not lanceolate as in the other tribes. The subcosta is heavy, straight to the margin as in the *Chorisoneurini*, but extends almost to the middle instead of being shorter. The radius does not have any apical posterior branch as in the *Anaplectinae*, and it seldom reaches the extreme apex. The media and cubitus are fused basally, so that differentiation between them is impossible as in some *Chorisoneurini*. The branches that are present usually pass diagonally towards the apex, instead of to the posterior margin. The plical furrow is almost straight, reaching the posterior margin somewhat before the middle, instead of being arcuate.

The wings of these forms have the appendiculate field extremely large, equal in length to that of the remainder of the wing. It is larger than in the other tribes and is rounded conical in outline instead of ovate. In general, the wing resembles that of the other tribes except that crossveins are not present between media and cubitus, or between cubitus and the first plical. The branches of the axillary do not fuse apically to bound the appendiculate field as in the other tribes.

The tegmina are subtrigonal in outline. The anterior margin is weakly arcuate, the apical margin is evenly rounded to obtuse angulate and the posterior margin is straight. The plical notch is not evident. The margin of the anal field is strongly arcuate. The humeral area is relatively small. The subcosta is heavy, simple and goes to the anterior margin slightly before the middle. The radius is almost straight and extends almost to the apex. It has a number of regular anterior rami, but no apical posterior branches are present. The media and cubitus are fused for a considerable portion of their length; usually a single branch rises before the middle. These two sectors then pass diagonally towards the apex, but actually go to the posterior margin. There is a rather large area without venation between the posterior branch and the plical furrow. The plical furrow is almost straight,

passing diagonally to the posterior margin which it reaches slightly before the middle. The anal area has traces of four simple veins. The most anterior one parallels the plical fold and the most posterior one more or less parallels the posterior margin. The other two which are somewhat more basal in position are subparallel.

The wing has the tremendous appendiculate field distinctive of this group. The anterior margin of the wing is sigmoid, and that of the appendiculate field is strongly arcuate; the apex of this field is rounded subobtusely angulate, and the posterior margin of the field is evenly arcuate, joining the margin of the anal field at a distinct angle. In outline the appendiculate field is subconical. The margin of the anal field is more or less evenly rounded. The subcosta is relatively long, nearly straight, reaching the anterior margin at the base of the convexity.  $R_1$  is distinct, parallels subcosta and is forked. The radius is strong, paralleling subcosta, then almost straight to the transverse fold, terminally upcurved. A number of regularly spaced anterior rami are present, but there is no apical posterior branch. Media basally is stalked on the radius, then almost straight to near the transverse fold, where it curves forward to meet the radius. The area between the radius and media is divided into a number of subrectangulate to subquadrate cells, by crossveins. The arculus is strong and oblique. The cubitus is practically straight to near the transverse fold, then curves forward to meet the media. The first plical vein rises near the base of cubitus, curves down, then parallels the second plical vein to near the transverse fold, terminally curving forward. No crossveins are present between media and cubitus or between cubitus and the first plical vein. The first plical vein, cubitus, media and radius are joined apically by their upturned tips, before the transverse fold, and form the inner margin of this portion of the appendiculate field. The second plical vein is strong, going almost to the transverse fold, its apex free. The third plical vein is basally free, practically straight to the apex of the appendiculate field. The branched axillary is arcuate and has three branches, the anterior one curving down along the transverse fold. The second branch meets the margin at the angulation formed by the appendiculate field and the anal field margin. The third branch goes directly to the margin of the anal field. Behind this are seven simple anal veins. A crossvein connects the third plical and branched axillary

just before the transverse fold. A single series of crossveins is present in the anal area.

Representative figured: *Plectoptera porcellana* (Saussure) figs. 72, 133. [Det. J. A. G. Rehn, 1922.] This species is the genotype. Female. Cayamas, Cuba.

#### ANAPLECTINAE

The members of this subfamily, while superficially resembling the Ectobiinae, differ from them in a number of important respects. The subcosta is distinctive in having a few regular anterior rami, thus resembling the Blattinae. The radius does not have any apical posterior branch as in most of the Ectobiinae. Media is a three-branched vein, with the branches attempting to parallel the posterior margin instead of going to this margin, as in related forms. The first branch ends at the extreme apex, and the other two at the apical portion of the posterior margin. The cubitus appears as a simple, sigmoid vein ending at the posterior margin. The notch at the end of the plical furrow is more evident than in the Ectobiinae.

The wing, while having a large appendiculate field, is rather distinctive in that this is elongate oval, not like that of the Ectobiinae. The subcosta is long as in related forms. The radius has a definite apical posterior branch, a condition not found in the Ectobiinae, while the base of media is lost as in some members of that subfamily. A basal stub of the first plical is present, but the remainder of this vein is completely lost, a condition not noticed elsewhere in the Blattaria. Although the apex of all the major vein stems curve forward before the transverse fold, they do not join apically as in the Ectobiinae. The third plical vein supports the appendiculate field as in the Ectobiinae, but reaches the margin posterior to the apex. The branches of the axillary reach to the transverse fold, but do not fuse apically as in most of the Ectobiinae.

In general, the tegmina are elongate oval. The anterior margin is evenly arcuate, more so than in related forms. The apex is narrowly rounded and the posterior margin is weakly arcuate. The plical notch is evident. The margin of the anal field is evenly arcuate. The humeral area is prominent. The subcosta is strong, direct, and reaches the anterior margin a little before the middle. This vein has three regularly spaced anterior rami. The radius is at first arcuate, then straight,

reaching the apical margin slightly before the extreme apex. It has approximately twelve regular, unbranched anterior rami. No apical posterior branches are present. Media is apparently three-branched, these more or less parallel to the posterior margin, the first branch going to the extreme apex, and the others to the posterior margin. The cubitus is a simple sigmoid vein, and for over half its course parallels the plical fold; its apex is at the posterior margin. The plical fold is evenly and strongly arcuate, and a distinct plical notch is evident. The four simple anal veins are more or less convergent towards the apical angle of the field.

The wing has the appendiculate field equal to a little less than one-third the total length. Folding is accomplished in the same manner as in the Ectobiinae. The anterior wing margin is strongly sigmoid, and the anterior margin of the appendiculate field is strongly arcuate. Apically it is evenly arcuate and the posterior margin is arcuate. The latter joins the margin of the anal field at an obtuse angle. The margin of the anal field is evenly arcuate. The subcosta is long and simple, reaching the margin at the start of the convexity. The radius is sigmoid, with  $R_1$  differentiated as a more oblique, anterior vein connected with the main stem by crossveins. There is a series of seven anterior radial rami, and at about the middle of these anterior rami, a posterior apical branch, which parallels the radius, originates. The apical posterior branch of radius is connected to the remainder of the radius by one crossvein. The base of media is not evident; this vein is weakly sigmoid, more strongly so at the base and apex. It is connected with the radius and the apical posterior branch by three crossveins, which divide the area into rectangulate cells. The arculus is strong and oblique. The cubitus is sigmoid, roughly paralleling media, and two crossveins connect these veins. Below the arculus is a stub representing the first plical vein. No other trace of this vein can be found. The second plical vein, which is approximate to the third plical, is sigmoid to the transverse fold. A single crossvein connects it with the cubitus. The third plical vein is weakly sigmoid to the transverse fold, then nearly straight to the margin of the appendiculate field. The appendiculate field is supported only by the third plical vein. The branched axillary is strong and has three major branches, one of which subdivides. All of these branches except the most posterior end at the transverse fold. The most posterior branch ends at the angle formed



by the margins of the appendiculate and anal fields. Behind this are eight simple anal veins. No crossveins connect the plicals with one another nor with the branched axillary, and there are no crossveins between the members of the branched axillary. Behind this, there is a single series of regular crossveins. The apices of all the systems anterior to the third plical vein curve forward, but they are not connected apically. The branches of the axillary which reach the transverse fold end blindly.

In this subfamily is placed *Anaplecta* and some related forms.

Although the tegmina and wings in these forms have achieved the same general result as is found in Ectobiinae the details are sufficiently different to warrant a separate subfamily.

Representative figured: *Anaplecta lateralis* Burmeister figs. 73, 132. [Det. Hebard, 1918.] This species is the genotype. Male. Porto Bello, Panama.

#### CEUTHOBIINAE

This distinctive subfamily, with the tegmina superficially resembling those of the Latindiinae, is clearly distinct from the Polyphagidae and seems to be related on one hand to the Pseudomopinae and on the other to the Ectobiinae and Anaplectinae. The tegmina have a forked subcosta, a feature of primitive blattids; but they do not have any anterior rami, in this agreeing with some of the Pseudomopinae. The radius has regular anterior rami basally as in that group, but the spaced apical rami are distinctive. A simple media and a three-branched cubitus, all paralleling the posterior margin, are again Pseudomopinae features. However, the few spaced crossveins are distinctive. The evenly arcuate plical furrow is reminiscent of the condition found in the Ectobiinae.

The wing with the distinct lobe bounding the branched axillary area, and as large as the preaxillary lobe immediately distinguishes this group from all the other Blattaria. However, a slight tendency in this direction is noted in some Epilamprinae. The simple subcosta and  $R_1$  with anterior rami are essentially Pseudomopinae characteristics. The radius with a few anterior rami, a simple media and cubitus all connected by spaced crossveins are characteristics shared with the Ectobiinae and Anaplectinae. The lack of an apical posterior

branch of radius is a condition also found in the Ectobiinae. The well-developed plical veins, and these being distinct from the branched axillary, and the reduction in the number of crossveins in the anal field, are shared with the forms that have an appendiculate field.

The tegmina are membranous and transparent, long and relatively narrow. The anterior margin is almost straight and passes into the rounded apical margin. The posterior margin is practically straight. There is no indication of a notch at the end of the plical furrow. The humeral area is but moderately developed, and the subcosta is heavy and short, being equal to about two-thirds the length of the anal area. It has a strong terminal fork. The radial system has eight regularly spaced anterior rami to slightly beyond the middle of the tegmina, beyond this there are a few rami dividing the marginal area into cells. The media is a simple vein, close to the radius basally, then curving away. It continues more or less straight to the extreme apex. Cubitus rises close to the base of the media, curves down at first and divides into two major branches, the more posterior of which again divides. The three simple branches go to the apical margin. Both media and cubitus parallel the posterior margin. The plical furrow is distinct and evenly arcuate. Only traces of venation are evident in the anal field. Irregular, spaced crossveins divide the area between the various vein branches into a series of subrectangulate cells.

The wing has the anterior margin straight and the apical margin rounded. A distinct plical notch is present. The margin bounding the branched axillary is arcuately produced equal to the preaxillary lobe; posterior to this is the evenly rounded margin of the remainder of the anal field. The subcosta is simple, reaching the margin well before the middle.  $R_1$  extends to about the middle and has a few (five) anterior rami. The radial sector extends almost to the apex of the wing and has a number of irregular rami, some of which secondarily branch. No apical posterior branch is present. The arculus is distinct and oblique. Media, which is unbranched, is stalked basally for a short distance on radius, then becomes free and goes to the wing apex. The cubitus is another simple vein going sigmoidly to the apical margin. The first plical vein is strong, simple, and slightly upcurved apically. The second plical vein is about one-half the wing length, simple and with its apex free. The third plical vein is free basally and extends to

the wing margin at the plical notch. The branched axillary has four branches which go to the expanded margin. Posterior to it are six, simple anal veins. Intercalated veins are present in this latter area. The preaxillary portion of the wing, as well as that of the branched axillary, is divided into a number of more or less rectangular cells by the irregular crossveins. Posterior to the branched axillary there is one or more series of anal crossveins.

This distinctive subfamily contains only the genus *Ceuthobia*.

Representative figured: *Ceuthobia fulvella* (Rehn) figs. 74, 139. [Det. Hebard, 1921.] The genotype is *Ceuthobia lepta* Hebard. Male. Carcaraña, Argentina.

#### OULOPTERYGIDAE

This distinctive family does not have any close relatives. The tegmina, with the dense punctation in the basal portion, the peculiar venation and a faint plical furrow, do not closely resemble those of any other members of the Blattaria. The subdiamond-shaped area, at about the apical third, between the radius and media, which lacks venation, is also distinctive.

The wing is very unusual with its appendiculate field lacking any venation, and in being curled spirally in repose. Moreover, the large area between radius and media which is divided into a number of irregular cells, and the abrupt termination of all the plical veins at the inner margin of the appendiculate field, will further differentiate this family from any other known Blattaria.

The tegmina are very dense and have numerous punctures in slightly more than the basal half; apically they become more membranous and the venation is more readily visible. The anterior margin curves forward basally making a large humeral area; beyond this it is nearly straight to near the apex. The apical margin is broadly rounded and the posterior margin is straight, the plical notch absent. The subcosta is simple, very heavy basally and sinuate, reaching the anterior margin, beyond the basal third somewhat resembling the condition found in some of the Pseudomopinae. The radius is strong and straight in the basal half, having irregular, simple anterior rami similar to some Pseudomopinae, beyond this it is curved forward to approximately the apical third, then recurved with its actual apex almost on a

line with its origin. Basally this portion has rather regular anterior rami; after the anterior curve, rami are more irregular, often having secondary branches, and going to the apico-anterior area. The media is simple, parallel to the radius until latter curves anteriorly; at this point, the media curves posteriorly and extends almost to the extreme apex. A subdiamond-shaped area without venation is present between these veins. Apically, they are connected by a series of crossveins. The cubitus is at first close to media and radius, but becomes free before the basal third. It has four or more arcuate branches, some of which divide, mostly ending at the apical margin, as in the Blattinae and other primitive groups. The plical furrow is indicated by a weak arcuate line going to the posterior margin slightly before the middle. Apparently at least six simple unbranched anal veins are present; their bases are not evident. Most of the tegmina are divided into a series of irregular cells by the numerous crossveins. This is more pronounced apically, where the tegmina are less dense.

The wing is divided into a relatively small preaxillary area, a moderate sized appendiculate field, and a large, full anal area. The anterior margin is basally straight, between the middle and apical third strongly arcuate, this arcuation roundly passing into the margin of the appendiculate field. This field has its entire margin strongly arcuate. The margin of the anal field is strongly and evenly arcuate. The subcosta is strong, simple and straight, reaching the costal margin at about the midpoint, as in some Epilamprinae.  $R_1$  is parallel to its sector in the basal half, then curves forward and ends in two simple branches. The radial sector, after paralleling  $R_1$ , has a number of irregular anterior rami, some secondarily branched. A number of irregular cells are formed in this area by crossveins. The media, which is simple, apparently rises from the top of a small but distinct arculus, and is concave throughout, apically ending at the radial sector much as in the Ectobiinae. The area between it and radius is divided into a number of oblique, transverse, irregular cells by crossveins, a condition distinctive of this family. The cubitus is strong and simple and parallels media to the transverse fold, as in the Anaplectinae and Ectobiinae. The simple media and cubitus represent a condition found in the other groups with an appendiculate field. The first plical vein is strong and distinct, slightly upcurved basally, then straight to the transverse fold.

The second and third plical veins are well developed and end at the transverse fold. The third is distinct from the branched axillary as in the Blattinae and Pseudomopinae. These veins are connected near their apices and with adjacent veins by a series of apical crossveins. In the Ectobiinae the plical veins are only connected with the adjacent veins. The entire appendiculate field is without any trace of venation. The branched axillary has an indefinite number of branches, as in some Epilamprinae. Counting the branches of the axillary, there are seventeen spaced, simple anal veins in the well-developed anal area.

In addition to *Oulopteryx*, it seems probable that *Melyroidea* Shelford is a member of this family.

Representative figured: *Oulopteryx meliponarum* Hebard figs. 75, 141. [Det. Hebard, Paratype.] This species is the genotype. Female. Fazenda do Sobrado, near Passo Quatro, Minas Geraes, Brazil.

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## EXPLANATION OF FIGURES

## Plate I

- Fig. 6.—*Arenivaga bolliana* (Saussure) Tegmen. Male, Brownville, Texas.  
 Fig. 7.—*Heterogamodes roseni* (Brancsik) Tegmen. Male, Bairam-Ali, Transcaspia, U.S.S.R.  
 Fig. 8.—*Corydia petiveriana* (Linnaeus) Tegmen. Male, Trichinopoly Presidency, Madras, India.  
 Fig. 9.—*Homoeogamia mexicana* (Burmeister) Tegmen. Male, Jalapa, V. C., Mexico.  
 Fig. 10.—*Tivia termes* (Karny) Tegmen. Male, Vryburg, British Bechuanaland, South Africa.  
 Fig. 11.—*Holocompsa nitidula* (Fabricius) Tegmen. Male, Lares, Puerto Rico.  
 Fig. 12.—*Euthyrrhapha pacifica* (Burmeister) Tegmen. Male, Mañaos, Brazil.  
 Fig. 13.—*Eupolyphaga sinensis* (Walker) Tegmen. Male, Ching-yang-fu, Kansu, China.  
 Fig. 14.—*Polyphaga aegyptiaca* (Linnaeus) Tegmen. Male, Zakaki, Cyprus.  
 Fig. 15.—*Dyscologamia pilosa* (Walker) Tegmen. Male, Grot by Baso, Sumatra.  
 Fig. 16.—*Dyscologamia pilosa* (Walker) Tegmen. Female, Fort de Kock, Sumatra.  
 Fig. 17.—*Latindia dohrniana* (Saussure and Zehntner) Tegmen. Female, Trinidad River, Panama.  
 Fig. 18.—*Compsodes delicatulus* (Saussure and Zehntner) Tegmen. Male, Cacao Trece Aguas, Guatemala.

## Plate II

- Fig. 19.—*Salganea morio* (Burmeister) Tegmen. Female, Darjiling District, Himalayas.  
 Fig. 20.—*Diploptera dytiscoides* (Serville) Tegmen. Male, Honolulu, Hawaii.  
 Fig. 21.—*Periplaneta americana* (Linnaeus) Tegmen. Female, Trichinopoly, Madras, India.  
 Fig. 22.—*Nyctibora noctivaga* Rehn Tegmen. Male, Changuinola District, Panama.  
 Fig. 23.—*Megaloblatta blaberoides* (Walker) Tegmen. Male, Muzo, Boyacá, Colombia.  
 Fig. 24.—*Blatta orientalis* Linnaeus Tegmen. Female, Bloomington, Indiana.  
 Fig. 25.—*Panesthia angustipennis* (Illiger) Tegmen. Male, Java.  
 Fig. 26.—*Deropeltis erythrocephala* (Fabricius) Tegmen. Male, Transvaal.  
 Fig. 27.—*Pseudoderopeltis brevicollis* (Serville) Tegmen. Male, Pretoria, Transvaal.  
 Fig. 28.—*Eurycotis floridana* (Walker) Tegmen. Male, Biscayne Bay, Florida.  
 Fig. 29.—*Blatta orientalis* Linnaeus Tegmen. Male, Bloomington, Indiana.

## Plate III

- Fig. 30.—*Calolampra irrorata* (Fabricius) Tegmen. Male, "Nouveau Holland" [= Australia].
- Fig. 31.—*Oniscosoma granicollis* (Saussure) Tegmen. Male, Dunkeld, Victoria, Australia.
- Fig. 32.—*Blaptica dubia* (Serville) Tegmen. Male, Buenos Aires, Argentina.
- Fig. 33.—*Perisphaerus contiguus* (Saussure) Tegmen. Male, Mount Lamington, N. E. Papua.
- Fig. 34.—*Litopeltis bispinosa* (Saussure) Tegmen. Male, Panama City, Panama.
- Fig. 35.—*Derocalymma versicolor* (Burmeister) Tegmen. Male, Kuke Pan, South Africa.
- Fig. 36.—*Phortioeca phorasoides* (Walker) Tegmen. Female, San Carlos, Costa Rica.
- Fig. 37.—*Leucophaea maderae* (Fabricius) Tegmen. Male, Bitje, Ja River, Cameroons.
- Fig. 38.—*Homalopteryx laminata* Brunner Tegmen. Male, Caparo, Trinidad.
- Fig. 39.—*Epilampra abdomen-nigrum* (DeGeer) Tegmen. Male, Caparo, Trinidad.
- Fig. 40.—*Morphna plana* (Burmeister) Tegmen. Male, Mousakande, Gamaduwa, Ceylon.

## Plate IV

- Fig. 41.—*Leurolestes pallidus* (Burmeister) Tegmen. Male, Key West, Florida.
- Fig. 42.—*Pycnoscelus surinamensis* (Linnaeus) Tegmen. Female, Fort de Kock, Sumatra.
- Fig. 43.—*Oxyhaloa buprestoides* (Saussure) Tegmen. Male, Baracoa, Cuba.
- Fig. 44.—*Paratropes phalerata* (Serville) Tegmen. Male, Muzo, Boyacá, Colombia.
- Fig. 45.—*Paranauphoeta lyrata* (Burmeister) Tegmen. Male, Kuching, N. W., Borneo.
- Fig. 46.—*Brachycola tuberculata* (Dalman) Tegmen. Female, Organ Mountains, Brazil.
- Fig. 47.—*Nauphoeta cinerea* (Olivier) Tegmen. Female, Fort de Kock, Sumatra.
- Fig. 48.—*Panchloria cubensis* Saussure Tegmen. Male, Villavicencio, Colombia.
- Fig. 49.—*Thorax porcellana* Saussure Tegmen. Male, Battaramulla, W.P., Ceylon.
- Fig. 50.—*Phoraspis picta* (Drury) Tegmen. Male, Brazil.
- Fig. 51.—*Hormetica apolinari* Hebard Tegmen. Female, Villavicencio, Colombia.

## Plate V

- Fig. 52.—*Archimandrita tesellata* Rehn Tegmen. Male, Colon, Panama.  
 Fig. 53.—*Blaberus giganteus* (Linnaeus) Tegmen. Male, Muzo, Boyacá, Colombia.  
 Fig. 54.—*Parcoblatta pensylvanica* (DeGeer) Tegmen. Male, Havana, Illinois.  
 Fig. 55.—*Parcoblatta pensylvanica* (DeGeer) Tegmen. Female, Ivy Hill, Mount Airy, Pennsylvania.  
 Fig. 56.—*Chromatonotus lamprus* Hebard Tegmen. Male, Corozal, Canal Zone, Panama.  
 Fig. 57.—*Euphyllodromia angustata* (Latrielle) Tegmen. Female, Gatun, Canal Zone, Panama.  
 Fig. 58.—*Cariblatta delicatula* (Guerin) Tegmen. Male, Montego Bay, Jamaica.  
 Fig. 59.—*Neoblattella fratercula* Hebard Tegmen. Male, Lancetilla, Honduras.  
 Fig. 59A.—*Aglaopteryx gemma* Hebard Tegmen. Female, Mobile, Alabama.  
 Fig. 60.—*Latiblattella rehni* Hebard Tegmen. Male, Cocoanut Grove, Florida.  
 Fig. 61.—*Euandrobatta curta* (Walker) Tegmen. Male, Kisantu, Lower Congo District, Belgian Congo.  
 Fig. 62.—*Ischnoptera rufa rufa* (DeGeer) Tegmen. Female, Barro Colorado, Canal Zone, Panama.

## Plate VI

- Fig. 63.—*Eustegasta poecila* (Schaum) Tegmen. Male, Amani, "German East Africa" [=Tanganyika Territory].  
 Fig. 64.—*Pseudomops intercepta* (Burmeister) Tegmen. Male, Cuernavaca, Mexico.  
 Fig. 65.—*Symploce capitata* (Saussure) Tegmen. Male, Havana, Cuba.  
 Fig. 66.—*Blattella germanica* (Linnaeus) Tegmen. Male, Key West, Florida.  
 Fig. 67.—*Supella supellectilium* Serville Tegmen. Male, Fort Leavenworth, Kansas.  
 Fig. 68.—*Balta similis* (Saussure) Tegmen. Female, Kauai Island, Hawaii.  
 Fig. 69.—*Ceratinoptera picta* Brunner Tegmen. Female, Gatun, Canal Zone, Panama.  
 Fig. 70.—*Ectobius lapponicus* (Linnaeus) Tegmen. Male, Europe.  
 Fig. 71.—*Chorisoneura flavipennis* Saussure and Zehntner Tegmen. Male, Venvidio, Sinaloa, Mexico.  
 Fig. 72.—*Plectoptera porcellana* (Saussure) Tegmen. Female, Cayamas, Cuba.  
 Fig. 73.—*Anaplecta lateralis* Burmeister Tegmen. Male, Porto Bello, Panama.  
 Fig. 74.—*Ceuthobia fulvella* (Rehn) Tegmen. Male, Carcaraña, Argentina.  
 Fig. 75.—*Oulopteryx meliponarum* Hebard Tegmen. Female, Fazenda do Sobrado, near Passo Quatro, Minas Geraes, Brazil.

## Plate VII

- Fig. 76.—*Arenivaga bolliana* (Saussure) Wing. Male, Brownsville, Texas.  
 Fig. 77.—*Eupolyphaga sinensis* (Walker) Wing. Male, Ching-yang-fu, Kansu, China.  
 Fig. 78.—*Homoeogamia mexicana* (Burmeister) Wing. Male, Jalapa, V. C., Mexico.  
 Fig. 79.—*Holocompsa nitidula* (Fabricius) Wing. Male, Lares, Puerto Rico.  
 Fig. 80.—*Latinidia dohrniana* (Saussure and Zehntner) Wing. Female, Trinidad River, Panama.  
 Fig. 81.—*Polyphaga aegyptica* (Linnaeus) Wing. Male, Zakaki, Cyprus.  
 Fig. 82.—*Heterogamodes roseni* (Brancsik) Wing. Male, Bairam-Ali, Transcaspia, U.S.S.R.  
 Fig. 83.—*Dyscologamia pilosa* (Walker) Wing. Male, Grot by Baso, Sumatra.  
 Fig. 84.—*Compsodes delicatulus* (Saussure and Zehntner) Wing. Male, Cacao Trece Aguas, Guatemala.  
 Fig. 85.—*Tivia termes* (Karny) Wing. Male, Vryburg, British Bechuanaland, South Africa.  
 Fig. 86.—*Euthyrrhapha pacifica* (Burmeister) Wing. Male, Mañaos, Brazil.  
 Fig. 87.—*Dyscologamia pilosa* (Walker) Wing. Female, Fort de Kock, Sumatra.

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- Fig. 88.—*Panesthia angustipennis* (Illiger) Wing. Male, Java.  
 Fig. 89.—*Salganea morio* (Burmeister) Wing. Female, Darjiling District, Himalayas.  
 Fig. 90.—*Nyctibora noctivaga* Rehn Wing. Male, Changuinola District, Panama.  
 Fig. 91.—*Megaloblatta blaberoides* (Walker) Wing. Male, Muzo, Boyacá, Colombia.  
 Fig. 92.—*Diploptera dytiscoides* (Serville) Wing. Male, Honolulu, Hawaii.  
 Fig. 93.—*Blatta orientalis* Linnaeus Wing. Male, Bloomington, Indiana.  
 Fig. 94.—*Periplaneta americana* (Linnaeus) Wing. Female, Trichinopoly, Madras, India.  
 Fig. 95.—*Pseudoderopeltis brevicollis* (Serville) Wing. Male, Pretoria, Transvaal.  
 Fig. 96.—*Deropeltis erythrocephala* (Fabricius) Wing. Male, Transvaal.

## Plate IX

- Fig. 97.—*Calolampra irrorata* (Fabricius) Wing. Male, "Nouveau Holland" [= Australia].  
 Fig. 98.—*Oniscosoma granicollis* (Saussure) Wing. Male, Dunkeld, Victoria, Australia.

- Fig. 99.—*Blaptica dubia* (Serville) Wing. Male, Buenos Aires, Argentina.  
 Fig. 100.—*Perisphaerus contiguus* (Saussure) Wing. Male, Mount Lamington, N. E. Papua.  
 Fig. 101.—*Phortioeca phoraspoides* (Walker) Wing. Female, San Carlos, Costa Rica.  
 Fig. 102.—*Leucophaea maderae* (Fabricius) Wing. Male, Bitje, Ja River, Cameroons.  
 Fig. 103.—*Litopeltis bispinosa* (Saussure) Wing. Male, Panama City, Panama.  
 Fig. 104.—*Derocalymma versicolor* (Burmeister) Wing. Male, Kuke Pan, South Africa.

## Plate X

- Fig. 105.—*Epilampra abdomen-nigrum* (DeGeer) Wing. Male, Caparo, Trinidad.  
 Fig. 106.—*Homalopteryx laminata* Brunner Wing. Male, Caparo, Trinidad.  
 Fig. 107.—*Pycnoscelus surinamensis* (Linnaeus) Wing. Female, Fort de Kock, Sumatra.  
 Fig. 108.—*Panchlora cubensis* Saussure Wing. Male, Villavicencio, Colombia.  
 Fig. 109.—*Morphna plana* (Burmeister) Wing. Male, Mousakande, Gam-maduwa, Ceylon.  
 Fig. 110.—*Nauphoeta cinerea* (Olivier) Wing. Female, Fort de Kock, Sumatra.  
 Fig. 111.—*Leurolestes pallidus* (Burmeister) Wing. Male, Key West, Florida.  
 Fig. 112.—*Paranauphoeta lyrata* (Burmeister) Wing. Male, Kuching, N. W., Borneo.  
 Fig. 113.—*Phoraspis picta* (Drury) Wing. Male, Brazil.

## Plate XI

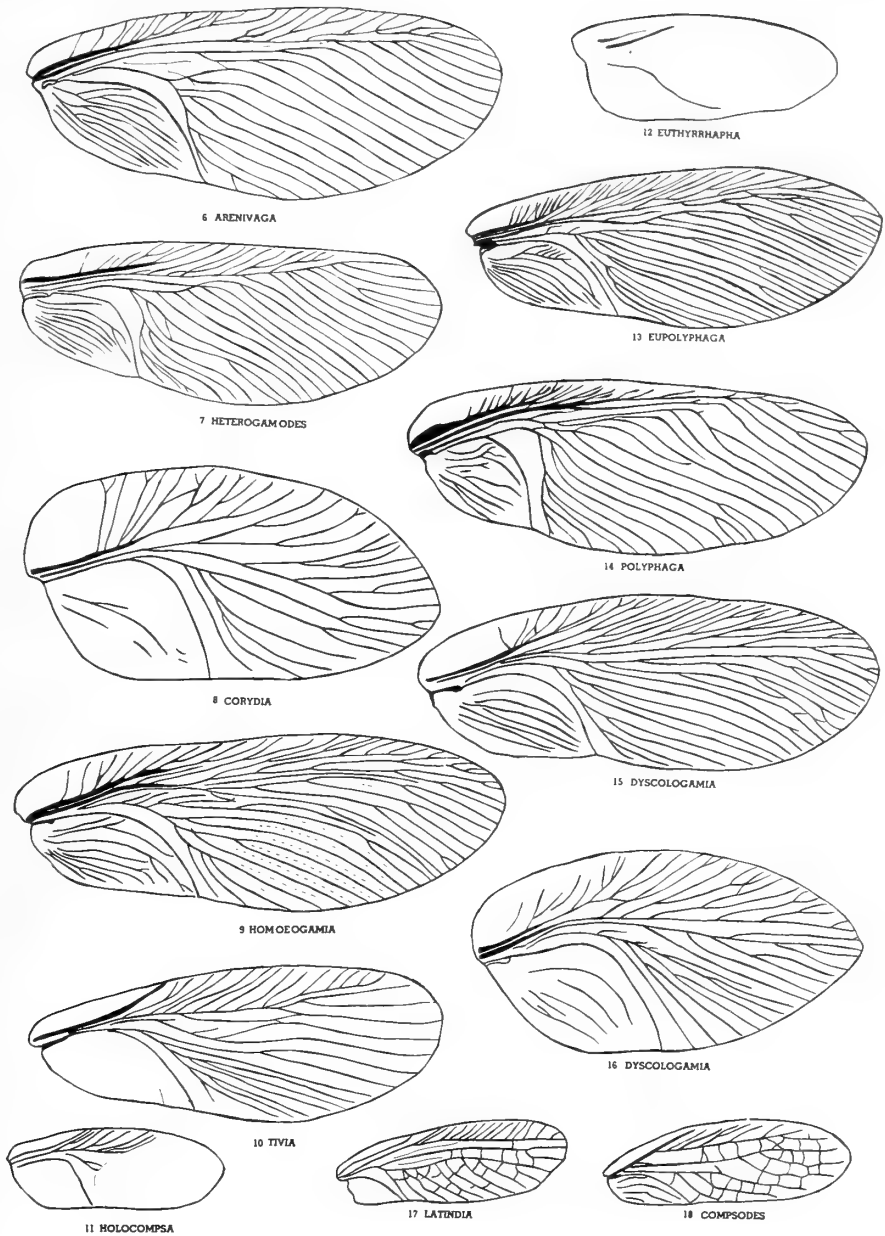
- Fig. 114.—*Thorax porcellana* Saussure Wing. Male, Battaramulla, W. P., Ceylon.  
 Fig. 115.—*Oxyhaloa buprestoides* (Saussure) Wing. Male, Baracoa, Cuba.  
 Fig. 116.—*Hormetica apolinari* Hebard Wing. Female, Villavicencio, Colombia.  
 Fig. 117.—*Archimandrita tesellata* Rehn Wing. Male, Colon, Panama.  
 Fig. 118.—*Blaberus giganteus* (Linnaeus) Wing. Male, Muzo, Boyacá, Colombia.  
 Fig. 119.—*Brachycola tuberculata* (Dalman) Wing. Female, Organ Mountains, Brazil.  
 Fig. 120.—*Paratrofes phalerata* (Serville) Wing. Male, Muzo, Boyacá, Colombia.

## Plate XII

- Fig. 121.—*Parcoblatta pensylvanica* (DeGeer) Wing. Male, Havana, Illinois.  
 Fig. 122.—*Chromatonotus lamprus* Hebard Wing. Male, Corozal, Canal Zone, Panama.  
 Fig. 123.—*Euphyllodromia angustata* (Latrielle) Wing. Female, Gatun, Canal Zone, Panama.  
 Fig. 124.—*Euandrobatta curta* (Walker) Wing. Male, Kisantu, Lower Congo District, Belgian Congo.  
 Fig. 125.—*Caribblatta delicatula* (Guerin) Wing. Male, Montego Bay, Jamaica.  
 Fig. 126.—*Ischnoptera rufa rufa* (DeGeer) Wing. Female, Barro Colorado, Canal Zone, Panama.  
 Fig. 127.—*Eustegasta poecila* (Schaum) Wing. Male, Amani, "German East Africa" [=Tanganyika Territory].  
 Fig. 128.—*Neoblattella fratercula* Hebard Wing. Male, Lancetilla, Honduras.  
 Fig. 129.—*Latiblattella rehni* Hebard Wing. Male, Cocoonut Grove, Florida.

## Plate XIII

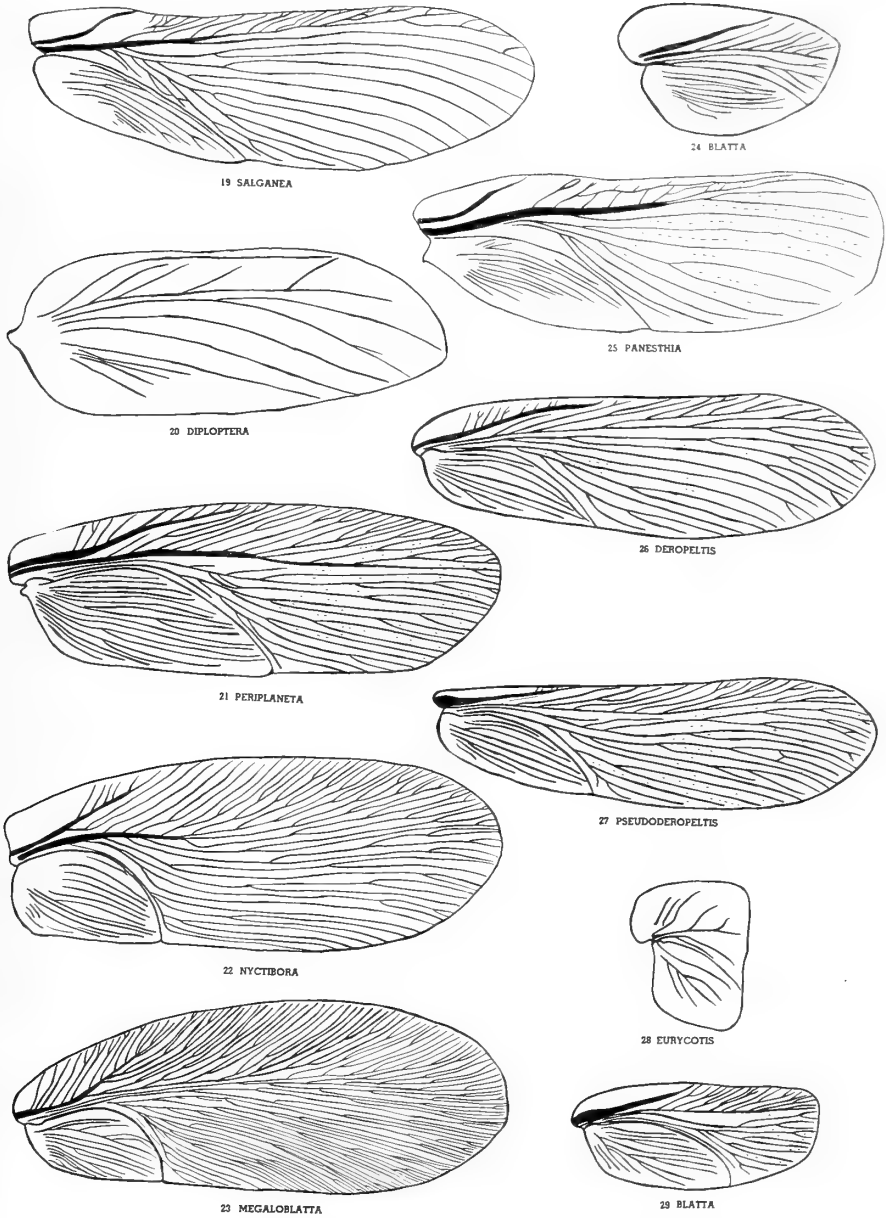
- Fig. 130.—*Symploce capitata* (Saussure) Wing. Male, Havana, Cuba.  
 Fig. 131.—*Supella supellectilium* Serville Wing. Male, Fort Leavenworth, Kansas.  
 Fig. 132.—*Anaplecta lateralis* Burmeister Wing. Male, Porto Bello, Panama.  
 Fig. 133.—*Plectoptera porcellana* (Saussure) Wing. Female, Cayamas, Cuba.  
 Fig. 134.—*Ectobius lapponicus* (Linnaeus) Wing. Male, Europe.  
 Fig. 135.—*Chorisoneura flavipennis* Saussure and Zehntner Wing. Female, Venvidio, Sinaloa, Mexico.  
 Fig. 136.—*Blattella germanica* (Linnaeus) Wing. Male, Key West, Florida.  
 Fig. 137.—*Pseudomops intercepta* (Burmeister) Wing. Male, Cuernavaca, Mexico.  
 Fig. 138.—*Balta similis* (Saussure) Wing. Female, Kauai Island, Hawaii.  
 Fig. 139.—*Ceuthobia fulvella* (Rehn) Wing. Male, Carcaraña, Argentina.  
 Fig. 140.—*Ceratinoptera picta* Brunner Wing. Female, Gatun, Canal Zone, Panama.  
 Fig. 141.—*Oulopteryx meliponarum* Hebard Wing. Female, Fazenda do Sobrado, near Passo Quatro, Minas Geraes, Brazil.



REHN—CLASSIFICATION OF THE BLATTARIA

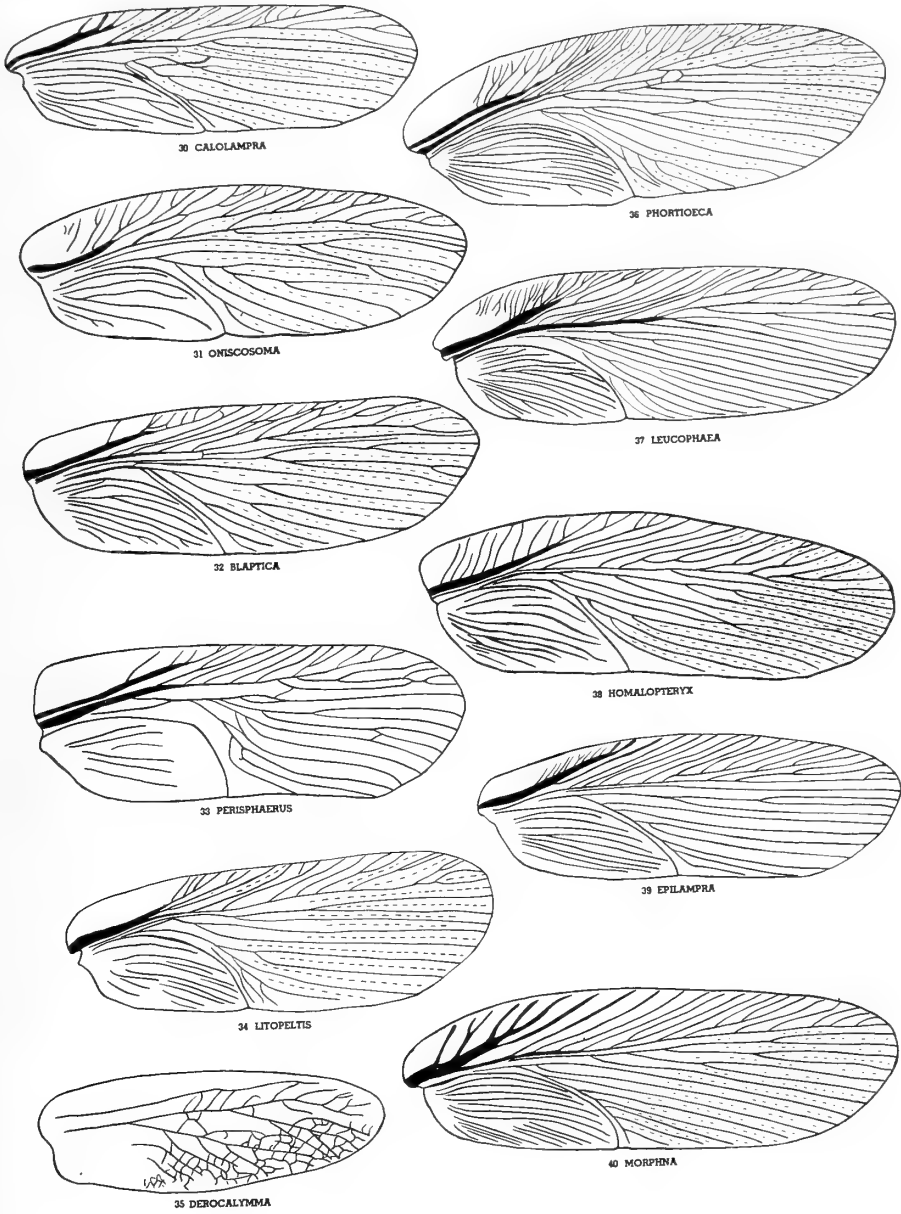






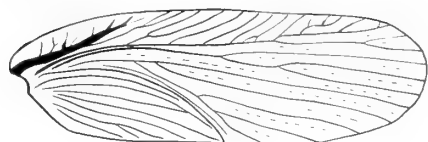
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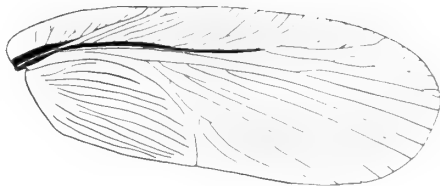


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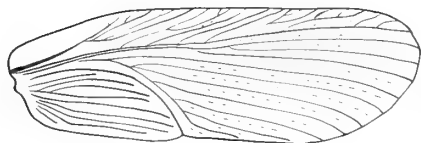




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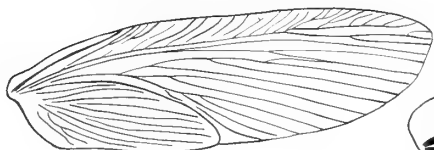
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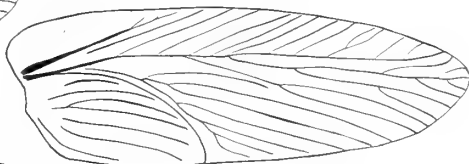
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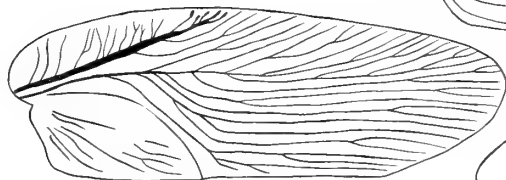
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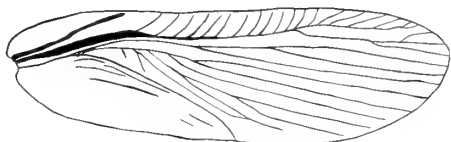
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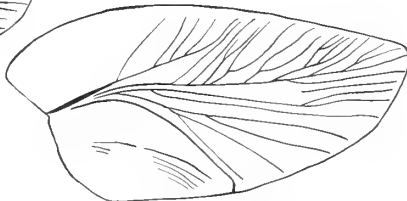
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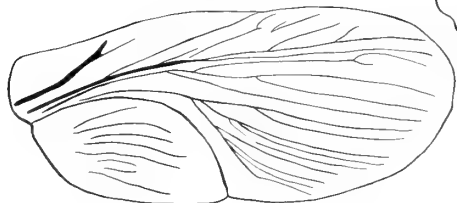
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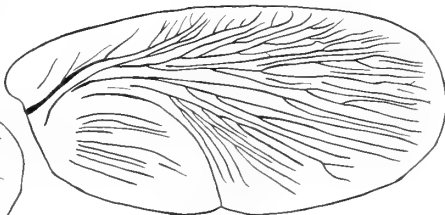
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50 PHORASPIS



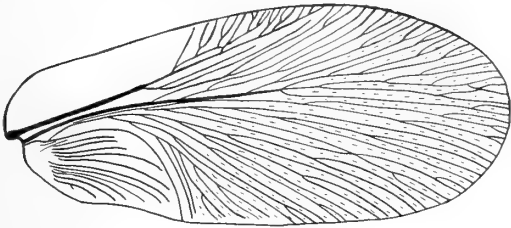
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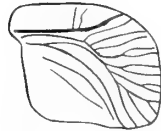
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REHN—CLASSIFICATION OF THE BLATTARIA

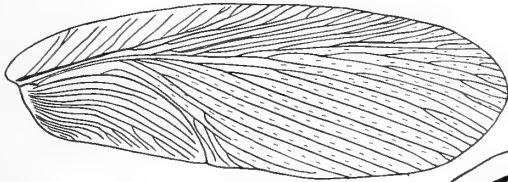




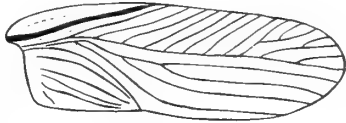
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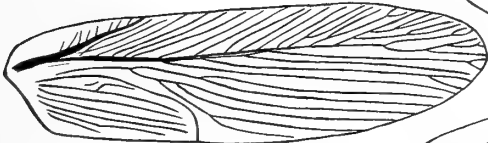
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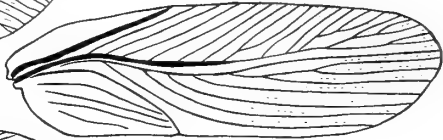
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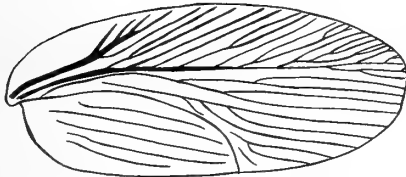
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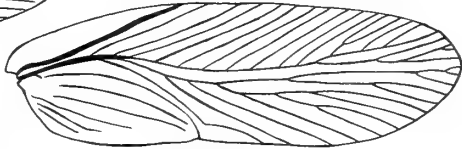
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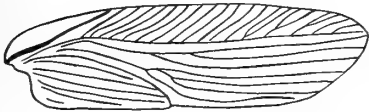
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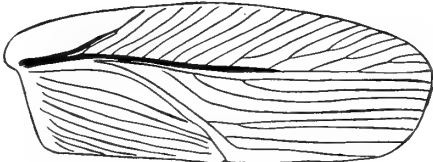
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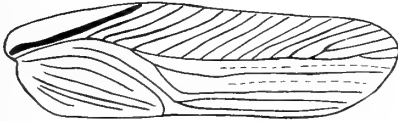
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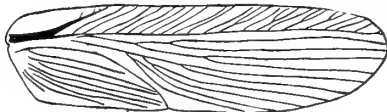
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61 EUANDROBLATA



57 EUPHYLLODROMIA

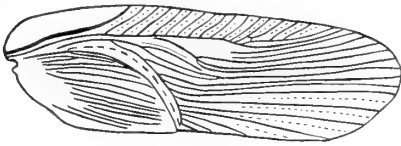


62 ISCHNOPTERA

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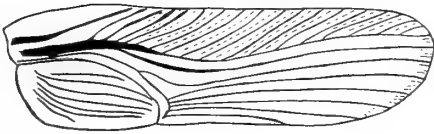




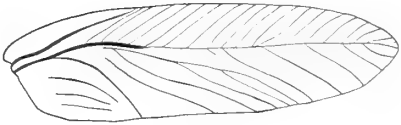
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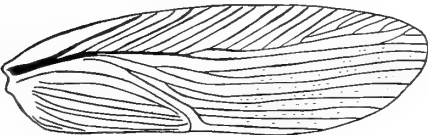
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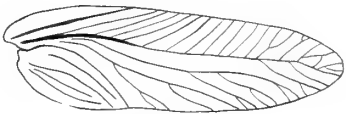
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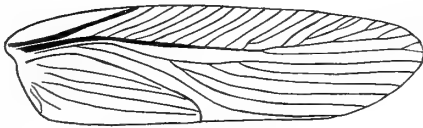
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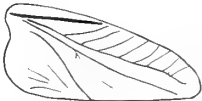
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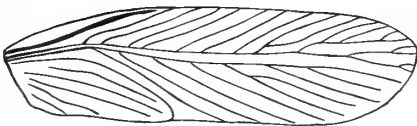
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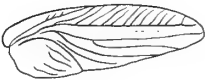
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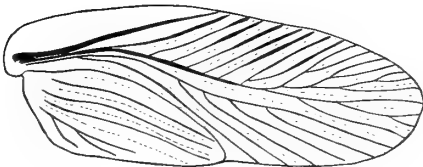
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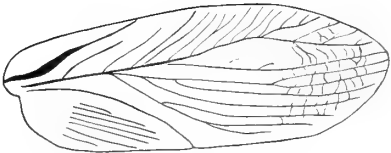
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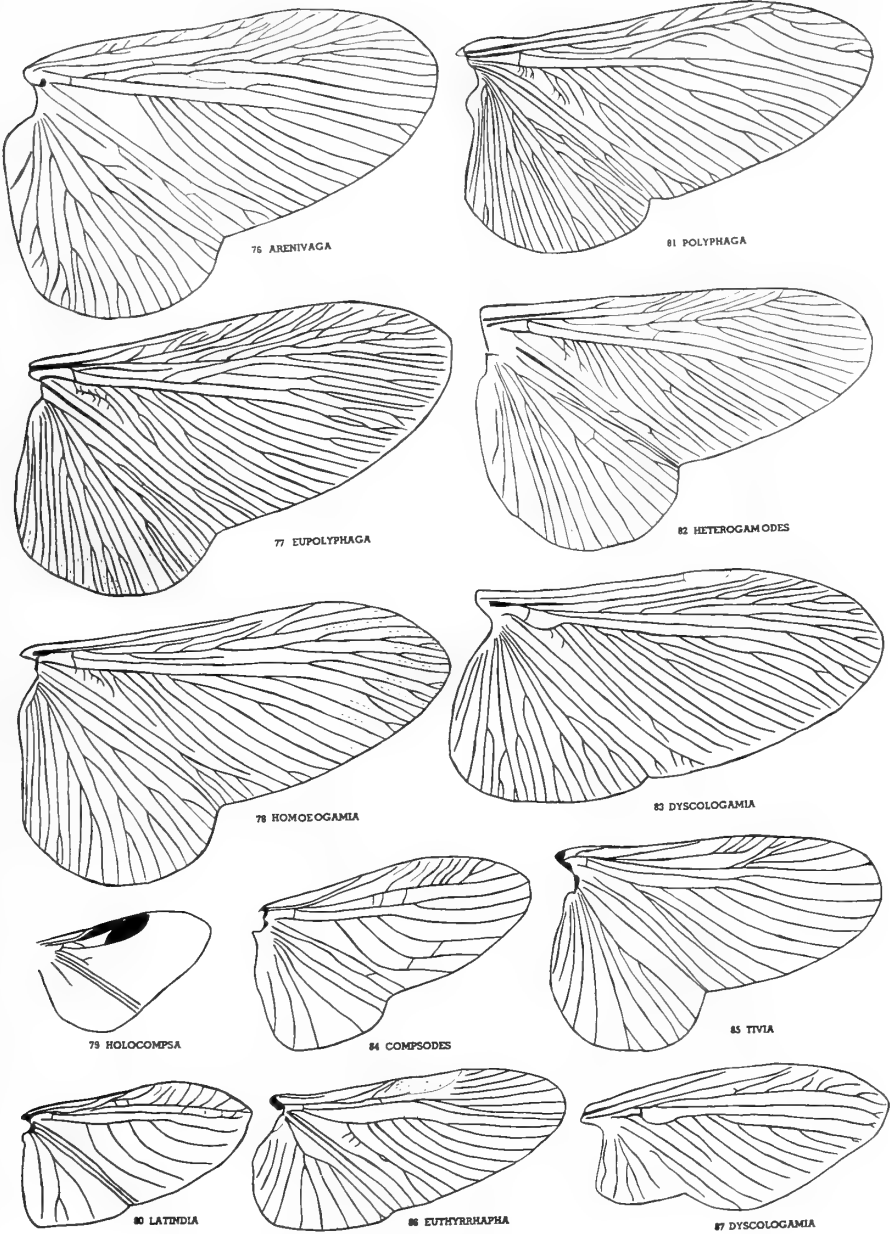
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75 OULOPTERYX

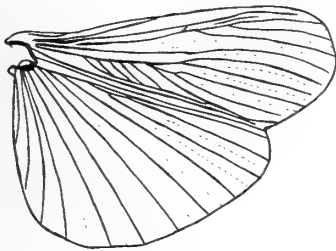
REHN—CLASSIFICATION OF THE BLATTARIA



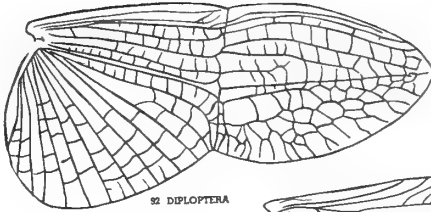


REHN—CLASSIFICATION OF THE BLATTARIA

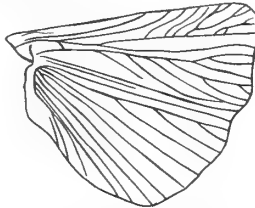




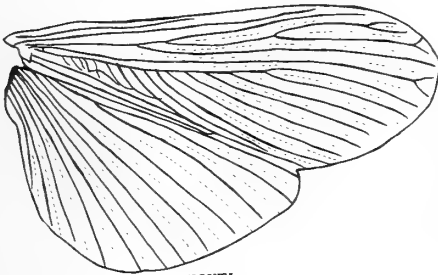
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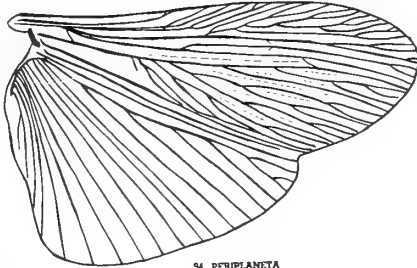
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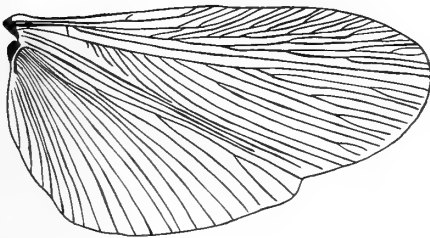
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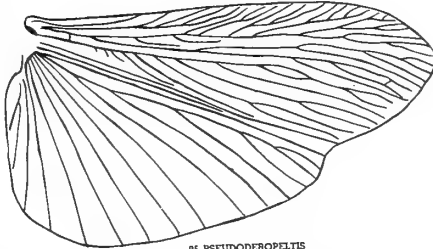
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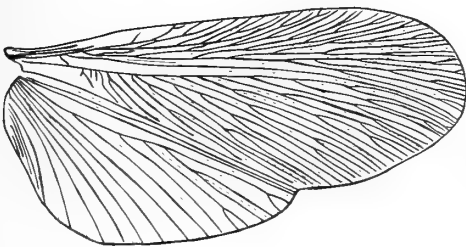
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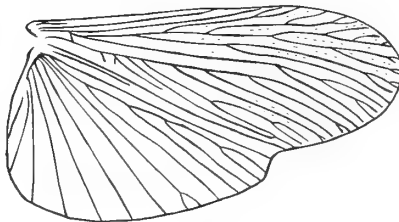
90 NYCTIBORA



95 PSEUDODEROPELTIS



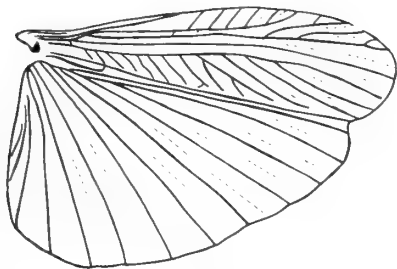
91 MEGALOBLATTA



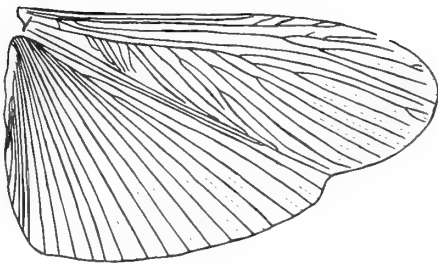
96 DEROPELTIS

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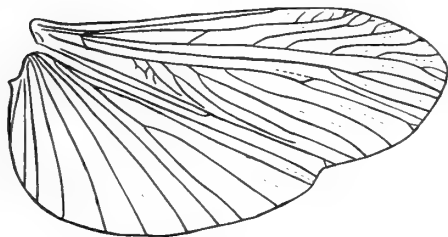




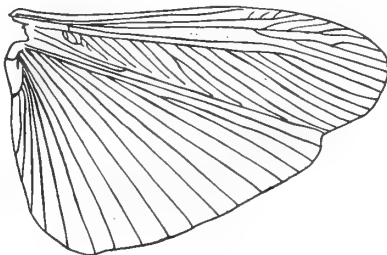
97 CALOLAMPIRA



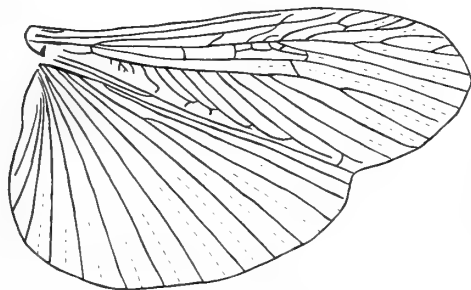
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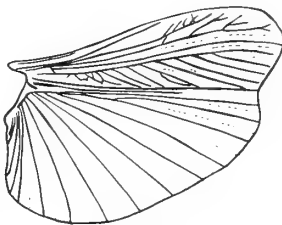
98 ONISCOSOMA



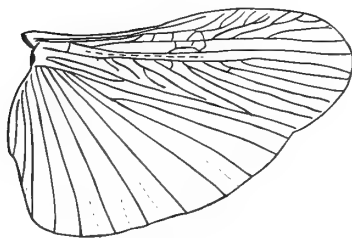
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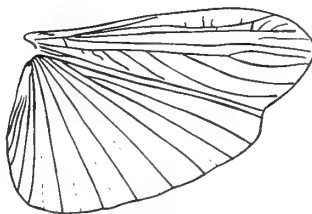
99 BLAPTICA



103 LITOPELTIS



100 PERISPHAERUS

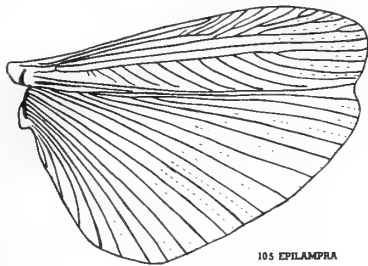


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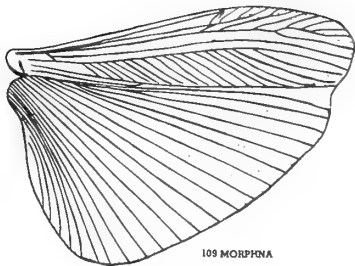
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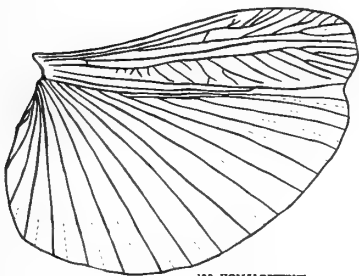




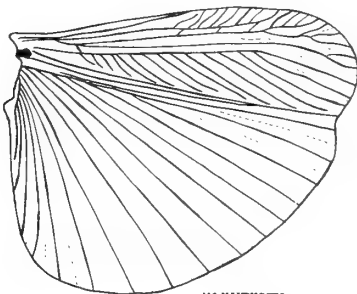
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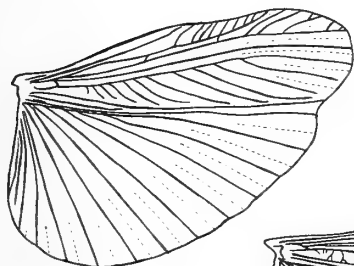
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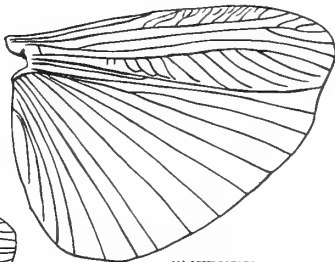
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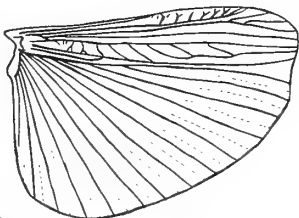
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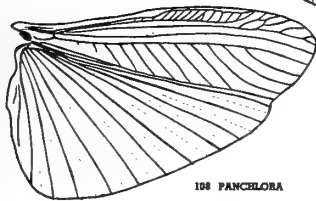
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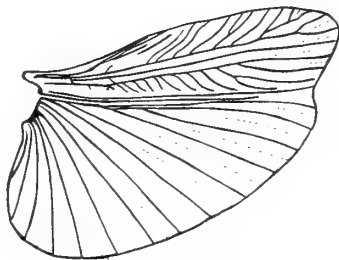
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112 PARANAUPHOETA



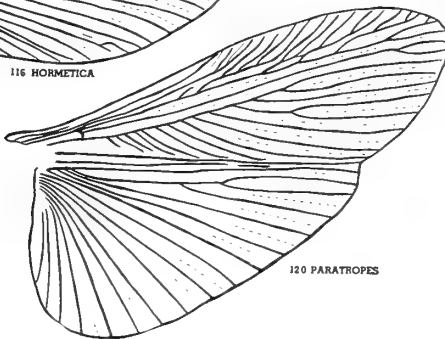
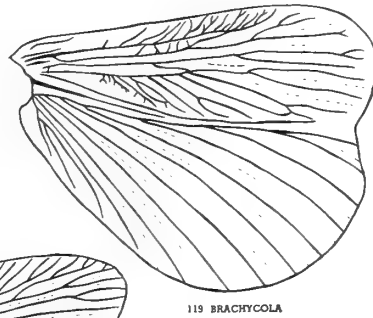
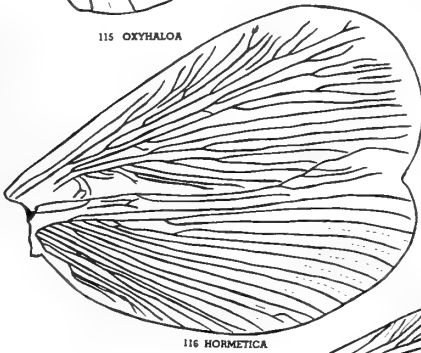
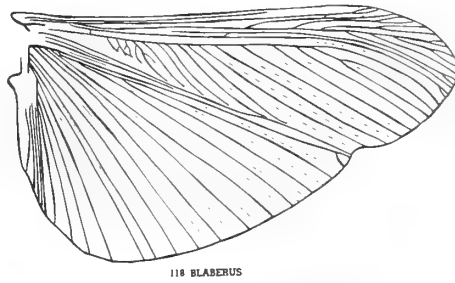
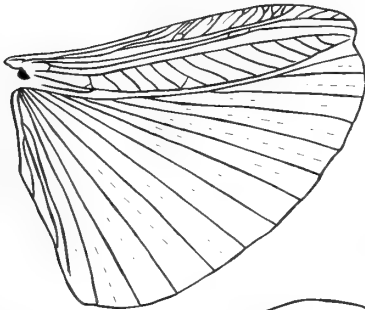
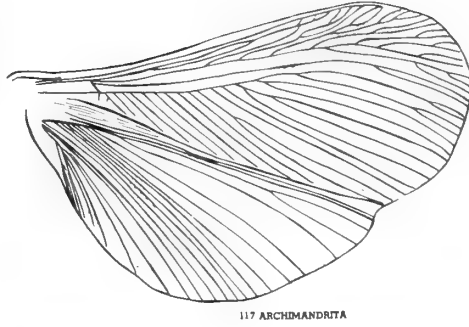
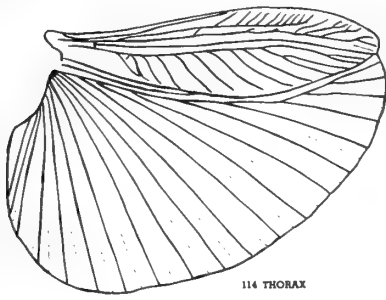
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113 PHORASPIS

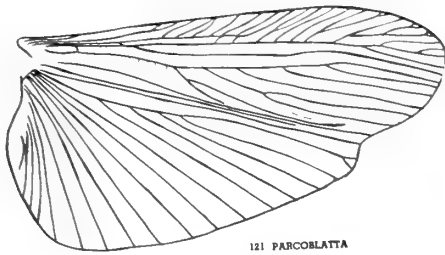
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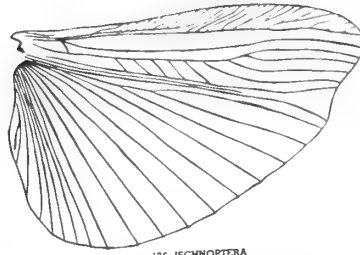


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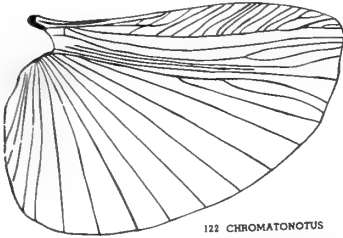




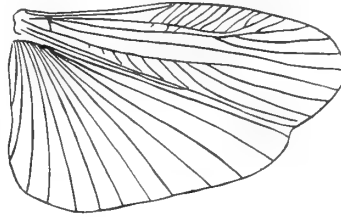
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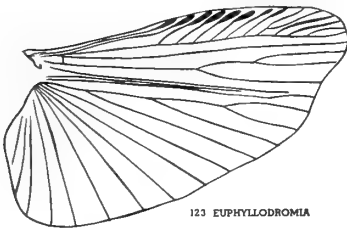
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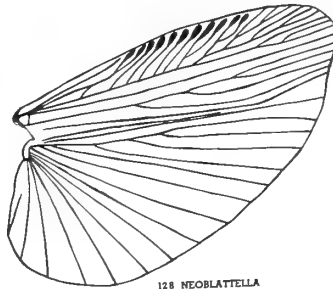
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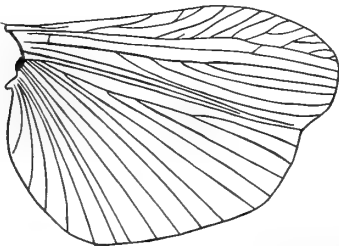
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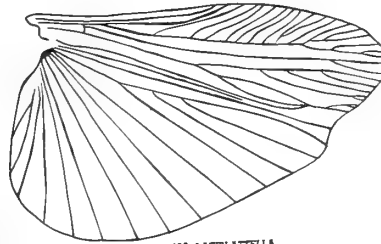
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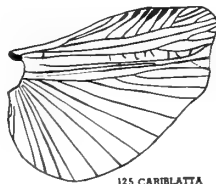
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124 EUANDROBLATTA

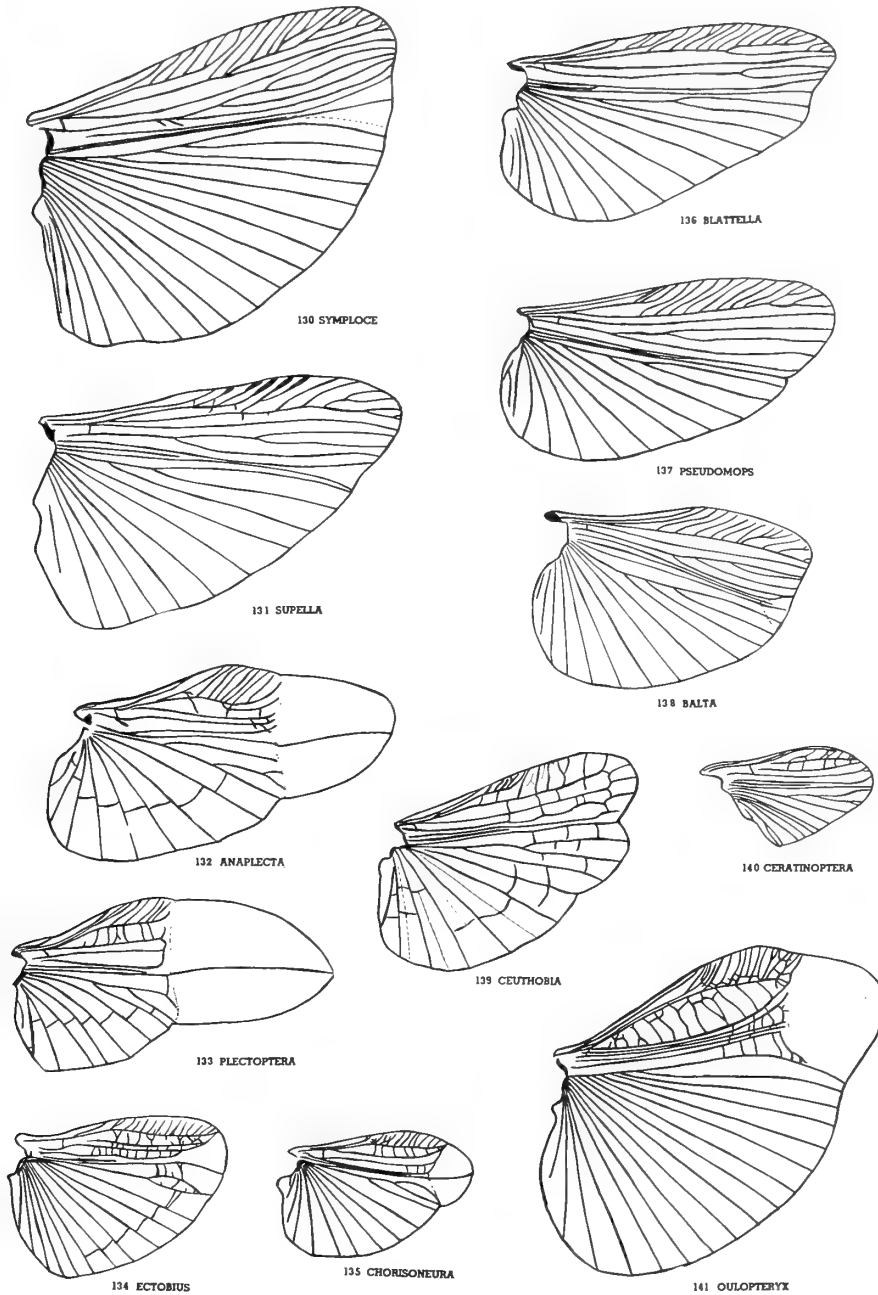


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